STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

JOSH STEIN
GOVERNOR

J.R. "JOEY" HOPKINS
SECRETARY

October 6, 2025

COUNTY: New Hanover

SUBJECT: Encroachment Contract E033-065-25-00127 – New Hanover County Sheriff's Office

Jonathan Hart
Chief Deputy
New Hanover County Sheriff's Office
3950 Juvenile Center Road
Castle Hayne, NC 28429

Dear Jonathan Hart:

Attached for your files is a copy of the above-referenced Right of Way Encroachment Contract, properly executed. This contract covers the following:

Installation of six (6) automatic license plat reader cameras on breakaway poles with self-contained solar power along US-117 Castle Hayne Road, NC-133 Castle Hayne Road, SR-1100 River Road, NC-140, SR-2048 Gordon Road, US-421in/near New Hanover County, NC.

APPROVED SUBJECT TO: Attached Special Provisions.

Sincerely,

Keith Garry
State Utilities Manager

DocuSigned by:
Frank Zdelar III
C320E97ED061490...

Frank "Butch" Zdelar
for Larry D. Sanders, MGIST, PE, CPM
State Encroachments Engineer

LDS/dbh
Attachment

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
UTILITIES UNIT
1555 MAIL SERVICE CENTER
RALEIGH NC 27699-1555

TELEPHONE: 919-707-6690
FAX: 919-250-4151
CUSTOMER SERVICE: 1-877-368-4968

WEBSITE: NCDOT.GOV

Location:
CENTURY CENTER COMPLEX
ENTRANCE A-1
1000 BIRCH RIDGE DRIVE
RALEIGH NC 27610

SPECIAL PROVISIONS
R/W 16.1A
New Hanover County Sheriff's Office
E033-065-25-00127

1. Approval may be rescinded upon failure to follow any of the provisions in this permit and may be considered a violation of the encroachment agreement.

2. The Encroaching party or their contractor shall provide the following notices prior to construction activity within the NCDOT Right of Way:
    a. Three (3) business days advance phone call at telephone (910) 398-9100 or email to bthughes@ncdot.gov to the District Engineer's office
    b. If the construction falls within the limits of an NCDOT managed construction project, five (5) business days advance phone call to the Resident Engineer, Joshua Pratt at (910) 398-9130 or email to jtpratt@ncdot.gov.

    Failure to provide these notifications prior to beginning construction is subject to the Division Engineer's discretion to cease construction activity for this encroachment. NCDOT reserves the right to cease any construction or maintenance work associated with this installation by the encroaching party until the construction or maintenance meets the satisfaction of the Division Engineer or their representative.

3. Prior to beginning work, it is the requirement of the Encroaching Party to contact the appropriate Utility Companies involved and make arrangements to adjust or relocate any utilities that conflict with the proposed work.

4. It shall be the responsibility of the encroaching party to determine the location of utilities within the encroachment area. NCGS § 87-115 through § 87-130 of the Underground Utility Safety and Damage Prevention Act requires underground utilities to be located by calling 811 prior to construction. The encroaching party shall be responsible for notifying other utility owners and providing protection and safeguards to prevent damage or interruption to existing facilities and maintain access to them.

5. The encroaching party shall notify the appropriate municipal office prior to beginning any work within the municipality's limits of jurisdiction.

6. Excavation within 1000 feet of a signalized intersection will require notification by the encroaching party to the Division Traffic Engineer at telephone number (910) 341-2200 no less than one week prior to beginning work. All traffic signals or detection cables must be located prior to excavation. Cost to replace or repair NCDOT signs, signals, pavement markings or associated equipment and facilities shall be the responsibility of the encroaching party.

7. At the option of the District Engineer, a preconstruction meeting including representatives of NCDOT, the encroaching party, contractors and municipality, if applicable, shall be required. A preconstruction conference held between a municipality (or other facility owner) and a contractor without the presence of NCDOT personnel with subsequent construction commencing may be subject to NCDOT personnel ceasing any work on NCDOT right-of-way related to this encroachment until such meeting is held. Contact the District office to schedule.

8. At the discretion of the District Engineer, a NOTIFICATION FOR UTILITY / NON-UTILITY ENCROACHMENT WITHIN NCDOT R/W form (See corresponding attachment) with the

scheduled preconstruction meeting and associated construction schedule details must be completed and submitted to the District Engineer's office a minimum of one week prior to construction.

9. At the discretion of the District Engineer, the encroaching party (not the utility contractor) shall make arrangements to have a qualified inspector, under the supervision of a Professional Engineer registered in North Carolina, on site at all times during construction. The registered Professional Engineer shall be required to submit a signed and PE sealed certification that the utility was installed in accordance with the encroachment agreement.

10. This approval and associated plans and supporting documents shall not be interpreted to allow any design change or change in the intent of the design by the Owner, Design Engineer, or any of their representatives. Any revisions or changes to these approved plans or intent for construction must be obtained in writing from the Division Engineer's office or their representative prior to construction or during construction if an issue arises during construction to warrant changes.

11. NCDOT does not guarantee the right of way on this road, nor will it be responsible for any claim for damages brought about by any property owner by reason of this installation. It is the responsibility of the encroaching party to verify the right of way.

12. Encroaching party shall be responsible for obtaining all necessary permanent and/or temporary construction, drainage, utility and/or sight distance easements.

13. All Right of Way and easements necessary for construction and maintenance shall be dedicated to NCDOT with proof of dedication furnished to the District Engineer prior to beginning work.

14. Traffic control shall be coordinated with the District Engineer and the Division Traffic Engineer, Stonewall (Stoney) Mathis at telephone (910) 341-2200, prior to construction.

15. WORK ZONE TRAFFIC CONTROL QUALIFICATIONS AND TRAINING PROGRAM

    All personnel performing any activity inside the highway right of way are required to be familiar with the NCDOT Maintenance / Utility Traffic Control Guidelines (MUTCG). No specific training course or test is required for qualification in the Maintenance /Utility Traffic Control Guidelines (MUTCG).

    All flagging, spotting, or operating Automated Flagger Assist Devices (AFAD) inside the highway right of way require qualified and trained Work Zone Flaggers. Training for this certification is provided by NCDOT approved training resources and by private entities that have been pre-approved to train themselves.

    All personnel involved with the installation of Work Zone Traffic Control devices inside the highway right of way are required to be qualified and trained Work Zone Installers. Training for this certification is provided by NCDOT approved training resources and by private entities that have been pre-approved to train themselves.

    All personnel in charge of overseeing work zone Temporary Traffic Control operations and installations inside the highway right of way are required to be qualified and trained Work Zone Supervisors. Training for this certification is provided by NCDOT approved training resources and by private entities that have been pre-approved to train themselves.

    For questions and/or additional information regarding this training program please refer to https://connect.ncdot.gov/projects/WZTC/Pages/Training.aspx or call the NCDOT Work Zone Traffic Control Section (919) 814-5000.

16. The party of the second part shall employ traffic control measures that are in accordance with the prevailing federal, state, local, and NCDOT policies, standards, and procedures. These policies, standards, and procedures include, but are not limited to the following:
    a. Manual on Uniform Traffic Control Devices (MUTCD) – North Carolina has adopted the MUTCD to provide basic principles and guidelines for traffic control device design, application, installation, and maintenance. North Carolina uses the MUTCD as a minimum requirement where higher supplemental standards specific to North Carolina are not established. Use fundamental principles and best practices of MUTCD (Part 6, Temporary Traffic Control).
    b. NCDOT Maintenance / Utility Traffic Control Guidelines – This document enhances the fundamental principles and best practices established in MUTCD Part 6, Temporary Traffic Control, incorporating NCDOT-specific standards and details. It also covers important safety knowledge for a wide range of work zone job responsibilities.

17. Ingress and egress shall be maintained to all businesses and dwellings affected by the construction of this encroachment. Special attention shall be paid to police, EMS and fire stations, fire hydrants, secondary schools, and hospitals.

18. Traffic shall be maintained at all times. All lanes of traffic are to be open during the hours of 7:00 A.M. to 9:00 A.M. and from 4:00 P.M. to 6:00 P.M. Monday through Friday, during any time of inclement weather, **or as directed by the District Engineer**. If the location of work calls for a rolling roadblock on Interstates and divided highway US routes, the restriction is to work only on Sunday from 1:00 A.M. to 10:00 A.M, **or as Directed by the District Engineer**. Any violation of these hours will result in ceasing any further construction by the Encroaching Party or their contractor.

19. Nighttime and weekend operations will NOT be allowed unless written approval is received from the District Engineer. If nighttime or weekend work is allowed or required, all signs must be retro-reflective, and a work zone lighting plan must be submitted for approval prior to construction.

20. Two-way traffic shall be maintained at all times unless designated by the District Engineer. Traffic shall not be rerouted or detoured without the prior written approval from the District Engineer. No utility work will be allowed on state holidays from 7:00 PM the night before through 9:00 AM the day prior to, following or during local events without prior approval from the District Engineer. If the construction is within 1000 feet of a school location or on a designated bus route, the construction shall be coordinated with the school start and end times to avoid traffic delays.

21. Work requiring lane or shoulder closures shall not be performed on both sides of the road simultaneously within the same area.

22. Any work requiring equipment or personnel within 5 feet of the edge of any travel lane of an undivided facility and within 10 feet of the edge of any travel lane of a divided facility shall require a lane closure with appropriate tapers per current *NCDOT Roadway Standard Drawings or MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES*.

23. At the discretion of the District Engineer, a traffic control plan shall be developed and submitted under the seal and signature of a Licensed North Carolina Professional Engineer prior to construction. The plan shall be specific to the site and adequately detailed. Issues such as the close proximity to intersections shall be addressed.

24. Sidewalk closures shall be installed as necessary. Pedestrian traffic shall be detoured around these closures and shall be signed appropriately and in accordance with The American with Disabilities Act Accessibility Guidelines. The encroaching party must adhere to the guidelines for accommodating pedestrians in encroachment work zones as described in the NCDOT Pedestrian Work Zone Accommodations Training found at https://www.youtube.com/watch?v=AOuYa5IW3dg&feature=youtu.be

25. The encroaching party shall comply with all applicable Federal, State and local environmental regulations and shall obtain all necessary Federal, State and local environmental permits, including but not limited to, those related to sediment control, stormwater, wetland, streams, endangered species and historical sites. Additional information can be obtained by contacting the NCDOT Roadside Environmental Engineer regarding the North Carolina Natural Heritage Program or the United States Fish and Wildlife Services. Contact the Division Roadside Environmental Engineer's Office at (910) 789-6190.

26. All erosion control devices and measures shall be constructed, installed, maintained, and removed by the Encroacher in accordance with all applicable Federal, State, and Local laws, regulations, ordinances, and policies. Permanent vegetation shall be established on all disturbed areas in accordance with the recommendations of the Division Roadside Environmental Engineer. All areas disturbed (shoulders, ditches, removed accesses, etc.) shall be graded and seeded in accordance with the latest *NCDOT Standards Specifications for Roads and Structures* and within 15 calendar days with an approved NCDOT seed mixture (all lawn type areas shall be maintained and reseeded as such). Seeding rates per acre shall be applied according to the Division Roadside Environmental Engineer. Any plant or vegetation in the NCDOT planted sites that is destroyed or damaged as a result of this encroachment shall be replaced with plants of like kind or similar shape.

27. Prior to installation, the Encroaching Party shall contact the District Engineer to discuss any environmental issues associated with the installation to address concerns related to the root system of trees impacted by boring or non-utility construction of sidewalk, roadway widening, etc.

28. The Encroaching Party is responsible for identifying project impacts to waters of the United States (wetlands, intermittent streams, perennial streams and ponds) located within the NCDOT right-of-way. The discharge of dredged or fill material into waters of the United States requires authorization from the United States Army Corps of Engineers (USACE) and certification from the North Carolina Division of Water Quality (NCDWQ). The applicant is required to obtain pertinent permits or certification from these regulatory agencies if construction of the project impacts waters of the United States within the NCDOT right-of-way. The applicant is responsible for complying with any river or stream Riparian Buffer Rule as regulated by the NCDWQ. The Rule regulates activity within a 50-foot buffer along perennial streams, intermittent streams and ponds. Additional information can be obtained by contacting the NCDWQ or the USACE.

29. State Transportation Improvement Project (STIP) U-5863, U-6202, & U-4902D is scheduled for future construction. Any encroachment determined to be in conflict with the construction of this NCDOT project shall be removed and/or relocated at the encroaching party's expense.

30. The contractor shall not begin the construction until after the traffic control and erosion control devices have been installed to the satisfaction of the Division Engineer or their agent.

31. The contractor shall perform all monitoring and record keeping and any required maintenance of erosion and sediment control measures to maintain compliance with stormwater regulations.

32. No access to the job site, parking or material storage shall be allowed along or from any **Controlled Access Roadway.**

33. The installation within the Control of Access fence shall not adversely affect the design, construction, maintenance, stability, traffic safety or operation of the controlled access highway, and the utility must be serviced without access from the through-traffic roadways or ramps.

34. The resetting of the Control of Access fence shall be in accordance with the applicable NCDOT standard and as directed by the Division Engineer or their representative.

35. An executed copy of the encroachment agreement, provisions and approved plans shall be present at the construction site at all times. If safety or traffic conditions warrant such an action, NCDOT reserves the right to further limit, restrict or suspend operations within the right of way.

36. If the approved method of construction is unsuccessful and other means are required, prior approval must be obtained through the District Engineer before construction may continue.

37. All disturbed areas are to be fully restored to current NCDOT minimum roadway standards or as directed by the Division Engineer or their representative. Disturbed areas within NCDOT Right-of-Way include, but not limited to, any excavation areas, pavement removal, drainage or other features.

38. The encroaching party shall notify the Division Engineer or their representative immediately in the event any drainage structure is blocked, disturbed or damaged. All drainage structures disturbed, damaged or blocked shall be restored to its original condition as directed by the Division Engineer or their representative.

39. Unless specified otherwise, during non-working hours, equipment shall be located away from the job site or parked as close to the right of way line as possible and be properly barricaded in order not to have any equipment obstruction within the Clear Zone. Also, during non-working hours, no parking or material storage shall be allowed along the shoulders of any state-maintained roadway.

40. The Encroaching Party and/or their Contractor shall comply with all OSHA requirements. If OSHA visits the work area associated with this encroachment, the District Office shall be notified by the encroaching party immediately if any violations are cited.

41. Any guardrail removed or damaged during construction shall be replaced or repaired to its original condition, meeting current NCDOT standards or as directed by the Division Engineer or their representative.

42. Right of Way monuments disturbed during construction shall be referenced by a registered Land Surveyor and reset after construction.

43. All Traffic signs moved during construction shall be reinstalled as soon as possible to the satisfaction of the Division Engineer or their representative.

44. All traffic control, asphalt mixes, structures, construction, workmanship and construction methods, and materials shall be in compliance with the most-recent versions of the following resources: *ASTM Standards*, *Manual on Uniform Traffic Control Devices, NCDOT Utilities Accommodations Manual, NCDOT Standard Specifications for Roads and Structures, NCDOT Roadway Standard Drawings,* NCDOT *Asphalt Quality Management System* manual, **and the approved plans.**

45. All wiring and related electrical work shall conform to the latest edition of the National Electrical Safety Code.

46. Any utility markers, cabinets, pedestals, meter bases and services for meter reading required shall be as close to the Right of Way line as possible. If it is not feasible to install at or near Right of Way line, then written approval shall be obtained from NCDOT prior to installation.

47. Luminaire and/or utility poles and guy wires shall be set as close to the Right of Way line as practical and outside the Clear Zone in accordance with the latest version of the AASHTO Roadside Design Guide (See corresponding attachment) or made breakaway in accordance with the requirements of NCHRP Report 350. Any relocation of the utility poles from the original design due to Clear Zone requirements shall require a re-submittal for the utility design.

48. Luminaire and/or utility poles shall be set a minimum of 5'-6" behind face of any guardrail or otherwise sufficiently protected. However, standard placement may be reduced to 3'-6" behind face of guardrail when posts are spaced 3'-1 ½", or where speed limit is less than 55 MPH.

49. Excavation material shall not be placed on pavement.

50. It is the responsibility of the encroaching party or their contractor to prevent any mud/dirt from tracking onto the roadway. Any dirt which may collect on the roadway pavement from equipment and/or truck traffic on site shall be immediately removed to avoid any unsafe traffic conditions.

51. Any pavement damaged because of settlement of the pavement or damaged by equipment used to perform encroachment work, shall be re-surfaced to the satisfaction of the District Engineer. This may include the removal of pavement and a 50' mechanical overlay. All pavement work and pavement markings (temporary and final) are the responsibility of the Encroaching Party.

52. The Encroaching party shall notify the District Engineer's office within 2 business days after construction is complete. The District Engineer may perform a construction inspection. Any deficiencies may be noted and reported to the encroaching party to make immediate repairs or resolve any issues to restore the right-of-way to a similar condition prior to construction, including pavement, signage, traffic signals, pavement markings, drainage, structures/pipes, or other highway design features.

53. At the discretion of the District Engineer, a final inspection report may be provided to the encroaching party upon satisfactory completion of the work.

54. If the actual construction differs from the approved plans associated with this encroachment, a copy of "as-built" plans shall be submitted to the District Engineer's office in a PDF format and in a current ESRI GIS format within 4 weeks of construction.

ATTACHMENT FORM

NOTIFICATION FOR UTILITY / NON-UTILITY ENCROACHMENT WITHIN NCDOT R/W

Instructions for use:
This form must be completed in its entirety and submitted directly to the designated personnel in the District Engineer's office via email, fax or hand delivery a minimum of one week prior to construction for the encroachment. If the designated NCDOT personnel names are unknown by the person completing this form, please contact the District Engineer's office to determine that contact info.

Date: _____ Submitted by Name: _____

To: District Personnel Name: _____
District Personnel Email: _____
District Fax No.: _____

This notification is to inform you that we (encroaching party or their contractor) will begin construction work on the following project in a minimum of one week.

Encroachment number
(assigned by NCDOT) for the project: E033-065-25-00127

Construction start date: _____

Approximate ending date: _____

Contact NCDOT inspector a minimum of 72 hrs. in advance to set-up Preconstruction meeting in the District Engineer's office or other location as directed by the District Engineer

Preconstruction meeting date & time: _____

Preconstruction meeting address: _____
_____

Type of project: _____
[Examples: power, telecommunication, water, sewer, gas, petroleum, other (describe)]

Contact Info for this project:

Contractor Company Name:
_____
Contractor Contact Name:
_____
Contractor Phone Number:
_____
Contractor Email:
_____

NCDOT Utility Inspector Name:
_____
NCDOT Utility Inspector Phone:
_____
NCDOT Utility Inspector Email:
_____
NCDOT Utility Project Manager Name:
_____
NCDOT Utility Project Manager Phone:
_____
NCDOT Utility Project Manager Email:
_____

STATE OF NORTH CAROLINA

ROUTE US-117, NC-133, SR-1100, NC-140, SR-2048, US-421 PROJECT _____ COUNTY OF New Hanover

DEPARTMENT OF TRANSPORTATION

-AND-

New Hanover County Sheriff's Office

3950 Juvenile Center Road

Castle Hayne, NC 28429

RIGHT OF WAY ENCROACHMENT AGREEMENT FOR NON-UTILITY ENCROACHMENTS ON PRIMARY AND SECONDARY HIGHWAYS

THIS AGREEMENT, made and entered into this the 6th day of October, 20 25, by and between the Department of Transportation, party of the first part; and the New Hanover County Sheriff's Office party of the second part,

W I T N E S S E T H

THAT WHEREAS, the party of the second part desires to encroach on the right of way of the public road designated as Route(s) US-421, SR-2048, SR-1521, NC-132, located within New Hanover County

with the construction and/or erection of: Solar powered LPR cameras on (6) MASH tested breakaway poles

WHEREAS, it is to the material advantage of the party of the second part to effect this encroachment, and the party of the first part in the exercise of authority conferred upon it by statute, is willing to permit the encroachment within the limits of the right of way as indicated, subject to the conditions of this agreement;

NOW, THEREFORE, IT IS AGREED that the party of the first part hereby grants to the party of the second part the right and privilege to make this encroachment as shown on attached plan sheet(s), specifications and special provisions which are made a part hereof upon the following conditions, to wit:

That the said party of the second part binds and obligates himself to install and maintain the encroaching facility in such safe and proper condition that it will not interfere with or endanger travel upon said highway, nor obstruct nor interfere with the proper maintenance thereof, to reimburse the party of the first part for the cost incurred for any repairs or maintenance to its roadways and structures necessary due to the installation and existence of the facilities of the party of the second part, and if at any time the party of the first part shall require the removal of or changes in the location of the said facilities, that the said party of the second part binds himself, his successors and assigns, to promptly remove or alter the said facilities, in order to conform to the said requirement, without any cost to the party of the first part.

That the party of the second part agrees to provide during construction and any subsequent maintenance proper signs, signal lights, flagmen and other warning devices for the protection of traffic in conformance with the latest Manual on Uniform Traffic Control Devices for Streets and Highways and Amendments or Supplements thereto. Information as to the above rules and regulations may be obtained from the Division Engineer of the party of the first part.

That the party of the second part hereby agrees to indemnify and save harmless the party of the first part from all damages and claims for damage that may arise by reason of the installation and maintenance of this encroachment.

It is clearly understood by the party of the second part that the party of the first part will assume no responsibility for any damage that may be caused to such facilities, within the highway rights of way limits, in carrying out its construction and maintenance operations.

That the party of the second part agrees to restore all areas disturbed during installation and maintenance to the satisfaction of the Division Engineer of the party of the first part. The party of the second part agrees to exercise every reasonable precaution during construction and maintenance to prevent eroding of soil; silting or pollution of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces or other property; or pollution of the air. There shall be compliance with applicable rules and regulations of the North Carolina Division of Environmental Management, North Carolina Sedimentation Control Commission, and with ordinances and regulations of various counties, municipalities and other official agencies relating to pollution prevention and control. When any installation or maintenance operation disturbs the ground surface and existing ground cover, the party of the second part agrees to remove and replace the sod or otherwise reestablish the grass cover to meet the satisfaction of the Division Engineer of the party of the first part.

That the party of the second part agrees to assume the actual cost of any inspection of the work considered to be necessary by the Division Engineer of the party of the first part.

That the party of the second part agrees to have available at the encroaching site, at all times during construction, a copy of this agreement showing evidence of approval by the party of the first part. The party of the first part reserves the right to stop all work unless evidence of approval can be shown.

Provided the work contained in this agreement is being performed on a completed highway open to traffic; the party of the second part agrees to give written notice to the Division Engineer of the party of the first part when all work contained herein has been completed. Unless specifically requested by the party of the first part, written notice of completion of work on highway projects under construction will not be required.

That in the case of noncompliance with the terms of this agreement by the party of the second part, the party of the first part reserves the right to stop all work until the facility has been brought into compliance or removed from the right of way at no cost to the party of the first part.

That it is agreed by both parties that this agreement shall become void if actual construction of the work contemplated herein is not begun within one (1) year from the date of authorization by the party of the first part unless written waiver is secured by the party of the second part from the party of the first part.

R/W (161A) : Party of the Second Part certifies that this agreement is true and accurate copy of the form R/W (161A) incorporating all revisions to date.

IN WITNESS WHEREOF, each of the parties to this agreement has caused the same to be executed the day and year first above written.

DocuSigned by:
Frank Zdelar III
C3XXXXXXXXXXXXXXXXXX

TION
Broadband Engineer

ATTEST OR WITNESS:

Edward J McMahon
Sheriff

Jonathan Hart, Chief Deputy

Second Party

INSTRUCTIONS

When the applicant is a corporation or a municipality, this agreement must have the corporate seal and be attested by the corporation secretary or by the empowered city official, unless a waiver of corporate seal and attestation by the secretary or by the empowered City official is on file in the Raleigh office of the State Utilities Manager. In the space provided in this agreement for execution, the name of the corporation or municipality shall be typed above the name, and title of all persons signing the agreement should be typed directly below their signature.

When the applicant is not a corporation, then his signature must be witnessed by one person. The address should be included in this agreement and the names of all persons signing the agreement should be typed directly below their signature.

This agreement must be accompanied, in the form of an attachment, by plans or drawings showing the following applicable information:

1. All roadways and ramps.
2. Right of way lines and where applicable, the control of access lines.
3. Location of the proposed encroachment.
4. Length and type of encroachment.
5. Location by highway survey station number. If station number cannot be obtained, location should be shown by distance from some identifiable point, such as a bridge, road, intersection, etc. (To assist in preparation of the encroachment plan, the Department's roadway plans may be seen at the various Highway Division Offices, or at the Raleigh office.)
6. Drainage structures or bridges if affected by encroachment.
7. Typical section indicating the pavement design and width, and the slopes, widths and details for either a curb and gutter or a shoulder and ditch section, whichever is applicable.
8. Horizontal alignment indicating general curve data, where applicable.
9. Vertical alignment indicated by percent grade, P.I. station and vertical curve length, where applicable.
10. Amount of material to be removed and/or placed on NCDOT right of way, if applicable.
11. Cross-sections of all grading operations, indicating slope ratio and reference by station where applicable.
12. All pertinent drainage structures proposed. Include all hydraulic data, pipe sizes, structure details and other related information.
13. Erosion and sediment control.
14. Any special provisions or specifications as to the performance of the work or the method of construction that may be required by the Department must be shown on a separate sheet attached to encroachment agreement provided that such information cannot be shown on plans or drawings.
15. The Department's Division Engineer should be given notice by the applicant prior to actual starting of installation included in this agreement.
16. Method of handling traffic during construction where applicable.
17. Scale of plans, north arrow, etc.

FLOCK SAFETY EQUIPMENT INSTALLATION

CASE NUMBER: 972582

PERMITTING JURISDICTION:

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

NORTH CAROLINA DOT
FLOCK SAFETY

ON BEHALF OF

NEW HANOVER COUNTY SHERIFF'S OFFICE

CONTACT LIST

PERMITTING

SHELBY FERGUSON
SHELBY.FERGUSON@FLOCKSAFETY.COM

PROJECT MANAGER

HEATHER PHILLIPS
HEATHER.PHILLIPS@FLOCKSAFETY.COM

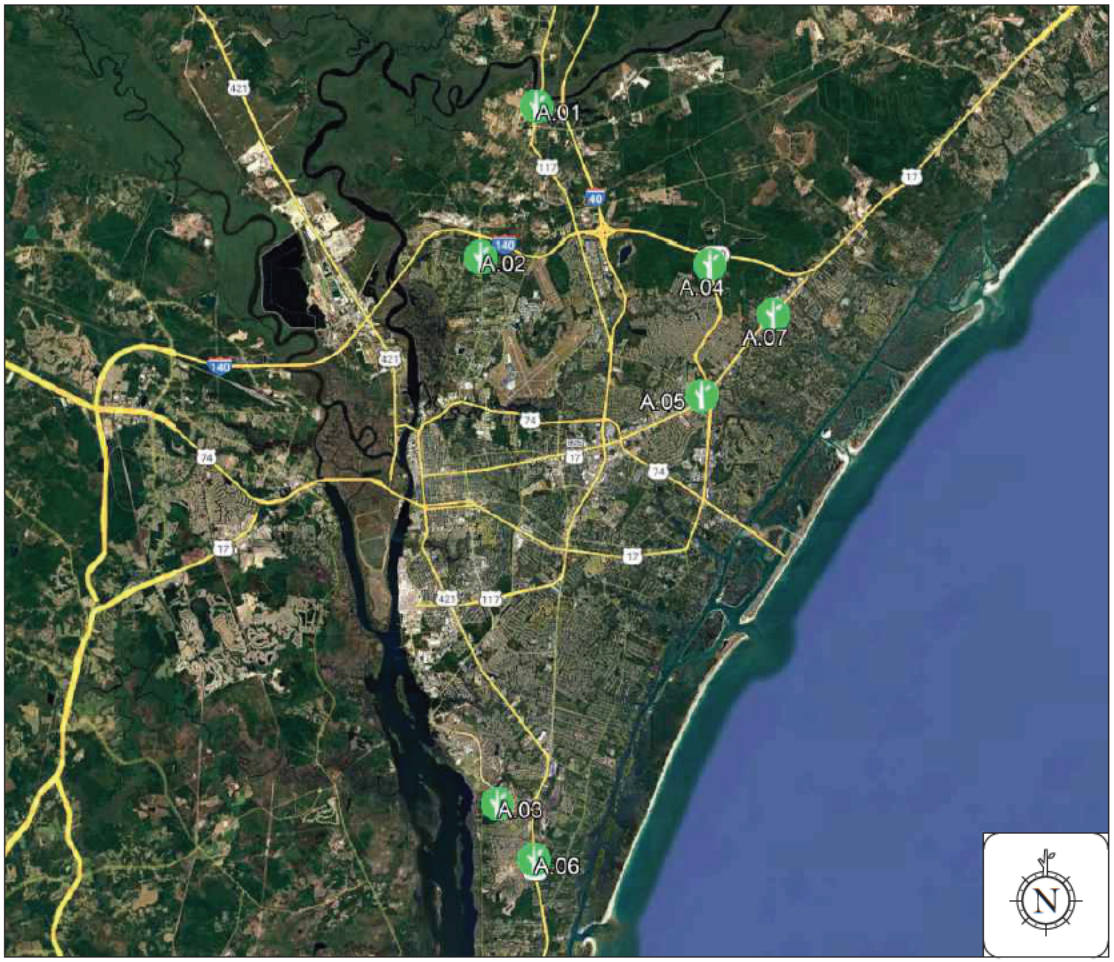
SEE APPROVED PERMIT FOR LISTED INSPECTOR

DRAWING INDEX

T.01	COVER SHEET & LOCATION MAPS
T.02	SYMBOLOGY & ABBREVIATIONS
GN.01 - GN.02	GENERAL NOTES
A.01 - A.07	PLAN DRAWINGS
SPEC.01 - SPEC.03	EQUIPMENT AND FOUNDATION DETAILS
TCP.01 - TCP.02	TRAFFIC CONTROL DETAILS

811

SAFETY IS IN YOUR HANDS.
EVERY DIG. EVERY TIME.



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NEW HANOVER COUNTY SHERIFF'S OFFICE

230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA 28403

flock safety
1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
-	-	-	-
3	06/11/2025	MPH	STAMPED SPECS
2	05/28/2025	MPH	REVISIONS
1	04/22/2025	RMD	REVISIONS
0	03/05/2025	MPH	PRELIM

I HEARBY CERTIFY THIS DOCUMENT WAS PREPARED BY MYSELF OR UNDER MY DIRECT SUPERVISION THAT I AM A DULY REGISTERED ENGINEER UNDER THE LAWS OF THE STATE OF NORTH CAROLINA.

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FLOCK SAFETY EQUIPMENT INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

COVER SHEET & LOCATION MAPS

SHEET:	REV:
T.01	0

THIS DOCUMENT HAS BEEN DRAWN BASED OFF THE MOST RECENT AVAILABLE DATA & AERIAL IMAGERY. THIS INCLUDES RIGHT OF WAY, EXISTING UTILITIES, & PRIVATE PROPERTY LINES. IT REMAINS THE RESPONSIBILITY OF OTHERS TO VERIFY ALL DATA PRIOR AND EXISTING SURRONDING FACILITIES TO VERIFY & CONFLICTS ABOVE & BELOW GRADE.
ALL CONSTRUCTION TO FOLLOW NORTH CAROLINA DEPARTMENT OF TRANSPORTATION GENERAL GUIDELINES. DO NOT SCALE DRAWINGS. CALL 811 PRIOR TO DIGGING.

LINETYPES

- RIGHT OF WAY
- EDGE OF PAVEMENT
- SIDEWALK
- CENTERLINE
- GAS
- WATER
- TELEPHONE
- ELECTRIC
- SANITARY SEWER (SEW)
- STORM DRAIN
- FENCE / GUARDRAIL
- CABLE TV
- STEAM
- OIL
- UNKNOWN UTILITY
- RAILROAD

SYMBOLOGY

- CAMERA - EXISTING
- CAMERA - PROPOSED
- POLE - PROPOSED
- POLE - EXISTING
- HANDHOLE - EXISTING
- HANDHOLE - PROPOSED
- PEDESTAL - EXISTING
- MANHOLE - EXISTING
- POINT OF INTEREST
- ACCESS POINT
- CULVERT - EXISTING
- FIRE HYDRANT - EXISTING
- WATER MAIN - EXISTING
- WATER VALVE - EXISTING
- GAS VALVE - EXISTING
- DOWN GUY AND ANCHOR
- OVERHEAD GUY
- BORING REQUIRED
- UG CONDUIT - EXISTING

ABBREVIATIONS:

ABAND	Abandoned
APPROX	Approximate
ASPH	Asphalt
BLDG	Building
CL	Centerline
CMP	Corrugated Metal Pipe
CO	County
CONC	Concrete
CSG	Casing
CT	Count
CULV	Culvert
DB	Directional Bore
DBH	Diameter at Breast Height
D.D.	Down Drain
DEPT	Department
DIA	Diameter
DIR	Directional
DIST	District
DOC	Depth of Cover
DOT	Department of Transportation
DWG	Drawing
DWY	Driveway
E MH	Electric Manhole
E MKR	Electric Line Marker
E PED	Electric Pedestal
E VLT	Electric Vault
EM	Electric Meter
ENC	Encased
ENG	Engineering
EOP	Edge of Pavement
EPB	Electric Pull Box
EXIST	Existing
FDH	Fiber Distribution Hub
FDT	Fiber Distribution Terminal
FH	Fire Hydrant
FO	Fiber Optic
FO MH	Fiber Optic Manhole
FO MKR	Fiber Optic Line Marker
FO VLT	Fiber Optic Vault
FOC	Face of Curb
FS	Filter Sock
G MH	Gas Manhole
G MKR	Gas Line Marker
G SD	Grated Storm Drain
GALV	Galvanized
GEO SRV MKR	Geodetic Survey Marker
GM	Gas Meter
GV	Gas Valve
GWMW	Groundwater Monitoring Well
HDPE	High Density Polyethylene
HH	Handhole
HWY	Highway
I.P.	Inlet Protection
ILA	In Line Amplifier
INC	Incorporated
INT	Intermediate
L/A ROW	Limited Access Right of Way
LF	Linear Feet
LOC MKR	Locating Marker
LP	Light Pole
MAX	Maximum
MB	Mailbox
MH	Manhole
MIN	Minimum
MIT	Mitigation
MKR	Marker
MMV	Meet Me Vault
MON	Monument
MOT	Maintenance of Traffic
NO	Number
OC	Open Cut
PRK MTR	Parking Meter
P/L	Property Line
PED	Pedestal
PI	Point of Inflection
PKG	Package
PVC	Polyvinyl Chloride
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RD MEM	Roadside Memorial
REQD	Required
RGS	Rigid Galvanized Steel
ROW	Right of Way
RR	Railroad
SCB	Sprinkler Control Box
SD	Storm Drain/Curb Inlet
SDMH	Storm Water Manhole
SEC.	Section
SF	Silt Fence
SMH	Sanitary Sewer Manhole
SPL	Splice
SS CO	Sanitary Sewer Clean Out
SS LIFT	Sanitary Sewer Lift Station
STA.	Station
STD	Standard
STR	Section Township Range
SWPPP	Storm Water Pollution Prevention Plan
T HH	Telecom Handhole
T MH	Telecom Manhole
T MKR	Telecom Line Marker
T PED	Telecom Pedestal
T VLT	Telecom Access Vault
T.P.	Trench Plug
TCB	Traffic Control Box
TCE	Temporary Construction Easement
TCV	Traffic Control Vault
TRF MH	Traffic Control Manhole
TSP	Traffic Signal Light
TYP	Typical
UG	Underground
UNK MH	Unknown Manhole
UNK PED	Unknown Pedestal
UNK UTL MKR	Unknown Utility Marker
UNK VLT	Unknown Vault
UTL LP	Utility Light Pole
UTL P	Utility Pole
VLT	Vault
VP	Gas Vent Pipe
W MH	Water Manhole
W MKR	Water Line Marker
W SPG	Water Spigot
W VLT	Water Vault
WM	Water Meter
WV	Water Valve

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NEW HANOVER COUNTY SHERIFF'S OFFICE

230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA 28403

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
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FLOCK SAFETY EQUIPMENT INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

COVER SHEET & LOCATION MAPS

SHEET:	REV:
T.02	0

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ALL CONSTRUCTION TO FOLLOW NORTH CAROLINA DEPARTMENT OF TRANSPORTATION GENERAL GUIDELINES. DO NOT SCALE DRAWINGS. CALL 811 PRIOR TO DIGGING.

GENERAL & CONSTRUCTION NOTES

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH STATE AND LOCAL AGENCY SPECIFICATIONS UNLESS SPECIFICALLY STATED OR SHOWN OTHERWISE HEREIN.
2. ALL WORK SHALL CONFORM TO ALL APPLICABLE ELECTRICAL CODES EXCEPT WHEN STATE DEPARTMENT OF TRANSPORTATION AND LOCAL AGENCY STANDARDS SUPERSEDE.
3. CONTRACTOR SHALL ENSURE ALL PROPOSED EQUIPMENT INSTALLED IS IN ACCORDANCE WITH NESC REQUIREMENTS AND CLEARANCES.
4. ALL CONSTRUCTION AND/OR MAINTENANCE ON THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RIGHT OF WAY SHALL CONFORM TO THE FEDERAL MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD), THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ROADWAY AND TRAFFIC DESIGN STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, PLANS PREPARATION MANUAL AND DRAINAGE MANUAL.
5. THE PERMITTING AGENCY RESERVES THE RIGHT TO MAKE ADJUSTMENTS TO ANY PERMITTED METHODS OF INSTALLATION, SCOPE OF WORK AND RESTORATION THAT MAY BE REQUIRED TO POSITIVELY SUPPORT LIFE, SAFETY AND ENVIRONMENTAL WELL BEING OF ALL USERS OF THE TRANSPORTATION SYSTEM.
6. SHOULD A CONFLICT ARISE BETWEEN THE DETAILS SHOWN IN THE PLANS AND THE DEPARTMENT OF TRANSPORTATION STANDARDS, THE ENGINEER/PERMITTEE SHALL IMMEDIATELY CONFER WITH THE DEPARTMENT'S ENGINEER IN ORDER TO RESOLVE THE DISCREPANCY. IN NO CASE WILL ANYTHING LESS THAN THE DEPARTMENTS MINIMUM STANDARDS BE ALLOWED.
7. FLOCK SAFETY SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES 48 HOURS PRIOR TO CONSTRUCTION.
   7.1. INSTALLS INVOLVING FLOCK SAFETY PROVIDED POLES, A MINIMUM OF 2' SEPARATION SHALL BE MAINTAINED FROM ALL EXISTING UTILITIES AND STORM DRAIN STRUCTURES.
8. THE PERMITTED WORK SCHEDULE IS DEFINED AS MONDAY THROUGH FRIDAY 7:00AM TO 5:30PM UNLESS OTHERWISE NOTED WITHIN THE PERMIT. ANY WORK DESIRED OUTSIDE OF THIS PERIOD MUST BE REQUESTED IN ADVANCE AND APPROVED BEFORE WORKING THE ALTERNATE SCHEDULE.
9. FLOCK SAFETY SHALL BE RESPONSIBLE TO APPLY AND OBTAIN AN APPROVED TRAFFIC CONTROL PLAN IN ACCORDANCE WITH MUTCD AND LOCAL STANDARDS AS REQUIRED.
10. WORK INVOLVING TEMPORARY LANE CLOSURES ARE TO BE DONE BETWEEN THE HOURS OF 8:00AM AND 5:00PM. MONDAY THROUGH FRIDAY UNLESS OTHERWISE STATED BY THE DEPARTMENT OF TRANSPORTATION.
11. CONTRACTOR SHALL PROVIDE SAFE ACCESS PER CURRENT GENERAL STANDARDS FOR ALL PEDESTRIAN TRAFFIC REGULATIONS ON ALL EXCAVATIONS OPENED IN THE TRAFFIC ZONE CONTROL AREA.
12. NO PEDESTRIAN PATHWAY IS TO BE REMOVED, BLOCKED, OR DISTURBED WITHOUT HAVING A SUFFICIENT DESIGNATED TEMPORARY PEDESTRIAN PATHWAY WITH ALL APPROPRIATE PEDESTRIAN MAINTENANCE OF TRAFFIC SIGNS IN PLACE PRIOR TO PATHWAY BEING AFFECTED.
   12.1. ALL TEMPORARY PEDESTRIAN PATHWAYS MUST BE FIRM AND UNYIELDING.
13. CONTRACTOR SHALL MAINTAIN ACCESS TO ALL ADJACENT PROPERTY IN THE VICINITY OF THE CONSTRUCTION.
14. NO WORK SHALL BE PERFORMED DURING THE WEEKS OF ANY STATE OR FEDERAL HOLIDAYS UNLESS OTHERWISE APPROVED BY THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION.
15. ALL WORK ZONES ARE TO BE SET UP AND MAINTAINED BY SOMEONE WHO HAS THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION INTERMEDIATE TRAFFIC CONTROL LEVEL TRAINING OR EQUIVALENT.
16. THE PERMITTING AGENCY RETAINS THE RIGHT TO MAKE ALTERATIONS TO THE PERMIT, ATTACHED SKETCH OR CHARACTER OF WORK AS MAY BE CONSIDERED NECESSARY OR DESIRABLE DURING THE PROGRESS OF THE WORK FOR SATISFACTORY COMPLETION OF THE PROPOSED CONSTRUCTION.
17. THE PERMITTEE SHALL NOTIFY THE PERMITTING AGENCY OF DATE OF COMPLETION, REQUEST A FINAL INSPECTION AND A NOTICE OF FINAL ACCEPTANCE.
18. IF THE PROPOSED CANNOT BE INSTALLED PER THE APPROVED PERMITTED PLAN AND BY GENERAL SPECIFICATIONS, A REVISED PLAN MUST BE PROVIDED TO THE DEPARTMENT FOR REVIEW AND APPROVAL PRIOR TO THE INSTALLATION OF PRODUCTS OR MATERIALS AT THE GIVEN LOCATIONS WHERE CONFLICTS OCCUR.
19. CONTRACTOR SHALL RESTORE RIGHT-OF-WAY TO EQUAL OR BETTER CONDITION UPON COMPLETION OF WORK AND TO THE SATISFACTION OF THE STATE DEPARTMENT OF TRANSPORTATION AND LOCAL AGENCY AT NO ADDITIONAL COMPENSATION.
   19.1. RESTORATION MAY INCLUDE BUT IS NOT LIMITED TO GRADING AND SODDING IN ANY DISTURBED AREA.
   19.2. ANY SIDEWALK DISTURBED WILL BE REPLACED BY SECTION WITHIN 72 HOURS TO THE STATE DEPARTMENT OF TRANSPORTATION SPECIFICATIONS.
20. IT WILL BE THE RESPONSIBILITY OF THE PERMITTEE TO REPAIR ANY DAMAGE TO GENERAL FACILITIES AND/OR PRIVATE PROPERTY CAUSED BY CONSTRUCTION OF THE PROJECT.
21. ALL ROADWAY PAVEMENT, CURBS,GUTTERS AND STORM WATER COLLECTORS WILL BE KEPT FREE OF MUD AND OTHER DEBRIS AT ALL TIMES DURING CONSTRUCTION.
22. NO STOCKPILING, STORING OR SEMI PERMANENT USE OF THE RIGHT OF WAY IS AUTHORIZED UNLESS SPECIFICALLY IDENTIFIED WITHIN THE PERMIT.
23. THE CONTRACTOR SHALL HAVE AN AUTHORIZED PERSON AVAILABLE AT/OR NEAR THE WORK SITE TO ADDRESS EMERGENCY ISSUES ASSOCIATED WITH THE PROJECT.

ADA COMPLIANCE NOTES:

1. ALL SIDEWALK CONSTRUCTION SHALL BE IN ACCORDANCE WITH ADA TITLE II AND ALL STATE DEPARTMENT OF TRANSPORTATION AND LOCAL STANDARDS. USE STATE DEPARTMENT OF TRANSPORTATION CURRENT EDITION STANDARDS FOR PEDESTRIAN CONTROL PLANS FOR CLOSURE OF SIDEWALK.
2. MINIMUM SIDEWALK CLEAR PEDESTRIAN ACCESS ROUTE (PAR) IS 48" WIDE.
3. NO OBSTRUCTION IS PERMITTED ALONG THE WIDTH OF THE SIDEWALK UP TO 7'-0" IN HEIGHT.

DRAWINGS

1. THE WORK SHALL BE PERFORMED IN STRICT ACCORDANCE WITH THE FOLLOWING ATTACHED DRAWINGS THAT ARE HEREBY MADE A PART OF THE STATEMENT OF WORK, BY THIS REFERENCE.

SPECIFICATIONS

1. THE WORK SHALL BE PERFORMED IN STRICT ACCORDANCE WITH THE SPECIFICATIONS CONTAINED IN THAT CERTAIN "MASTER AGREEMENT, OUTSIDE PLANT MAINTENANCE CONSTRUCTION SERVICES," PROVIDED THAT SUCH AN AGREEMENT EXISTS BETWEEN FLOCK SAFETY AND CONTRACTOR. IN THE ABSENCE OF SUCH AN AGREEMENT, THE SPECIFICATIONS CONTAINED IN AN AGREEMENT TO BE EXECUTED BY THE PARTIES PRIOR TO THE COMMENCEMENT OF WORK SHALL GOVERN.

MATERIALS

1. INSTALLER SHALL RECEIVE FLOCK SAFETY MATERIALS AT A FLOCK SAFETY LEASED WAREHOUSE FACILITY OR AT THE LOCAL TSO LOCATED AT (CONTACT 24 HOURS IN ADVANCE): 1170 HOWELL MILL RD NW, ATLANTA, GA 30318.
   1.1. ALL UNUSED AND REQUESTED SALVAGED MATERIAL TO BE RETURNED TO SAME ADDRESS.
2. THE RECEIPT OF ALL MATERIALS SHALL BE CONSTRUED AS CONCLUSIVE EVIDENCE THAT THE CONTRACTOR HAS MADE ALL NECESSARY EXAMINATION AND INSPECTIONS, AND IS SATISFIED AS TO THE QUALITY AND QUANTITY OF MATERIALS RECEIVED.
3. ANY AND ALL MATERIALS THAT MAY BECOME LOST, STOLEN OR DAMAGED SHALL BE REPLACED BY THE CONTRACTOR AT HIS SOLE EXPENSE, AND ANY DELAY INCURRED SHALL NOT BE CAUSE FOR AN EXTENSION IN TIME

SAFETY AND PRECAUTIONS

1. ALL PERSONNEL ARE REQUIRED TO ABIDE BY ALL RULES AND REGULATIONS SET FORTH IN THE FLOCK SAFETY REQUIREMENTS, RAILROAD SAFETY CODE AND GOVERNING JURISDICTION.
2. THE WORK UNDER THIS INSTALLATION WILL BE CONSTRUCTED ALONG RIGHTS OF WAY THAT MAY CONTAIN EXISTING AND OPERATIONAL UTILITIES. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR LOCATING EXISTING UTILITIES AND FOR COMPLIANCE WITH THE REQUIREMENTS OF ANY STATEWIDE AND/OR LOCAL AREA IN ADVANCE OF ANY EXCAVATION, BORING OR PLACING WORK AND THE CONTRACTOR SHALL LOCATE AND EXPOSE BY HAND ALL EXISTING SUBSURFACE PLANT. ANY DAMAGE CAUSED BY THE CONTRACTOR SHALL BE REPAIRED BY THE CONTRACTOR AT HIS SOLE EXPENSE AND ANY DELAY INCURRED SHALL NOT BE CAUSE FOR AN EXTENSION IN THE TIME OF THE CONTRACT.
3. INSTALLER SHALL BE RESPONSIBLE FOR THE PROTECTION AND MAINTENANCE OF PUBLIC AND PRIVATE PROPERTIES. INSTALLER SHALL PROTECT, SHORE, BRACE, SUPPORT AND MAINTAIN ALL UNDERGROUND PIPES, CONDUITS, DRAINS AND OTHER SUBSURFACE STRUCTURES UNCOVERED OR OTHERWISE AFFECTED BY THE WORK.
4. INSTALLER SHALL BE RESPONSIBLE FOR ALL DAMAGE TO STREETS, ROADS, HIGHWAYS, SHOULDERS, DITCHES, EMBANKMENTS, CULVERTS, BRIDGES OR OTHER PUBLIC OR PRIVATE PROPERTY OR FACILITY, REGARDLESS OF LOCATION OR CHARACTER, WHICH MAY BE CAUSED BY THE WORK, OR BY MOVING, HAULING, OR OTHERWISE TRANSPORTING EQUIPMENT, MATERIALS OR WORKERS TO OR FROM WORK OR ANY SITE THEREOF, WHETHER BY THE CONTRACTOR OR SUBCONTRACTORS.

STAKING AND SCHEDULING

1. ALL STAKING WILL BE PROVIDED BY FLOCK SAFETY. REQUIRED RIGHT OF WAY CLEARING SHALL BE COMPLETED PRIOR TO STAKING: THEREFORE, THE INSTALLER SHALL COORDINATE ALL CLEARING AND PLACING OPERATIONS WITH THE FLOCK SAFETY PROJECT SUPERVISOR TO AVOID DELAYS AND INTERFERENCE.
2. FLOCK SAFETY WILL PROVIDE RAILROAD, FLAGMEN AND SIGNALMEN AS REQUIRED; HOWEVER, THE CONTRACTOR SHALL BE REQUIRED TO COORDINATE ITS NEEDS FOR SUCH SIGNALMEN AND FLAGMEN WITH FLOCK SAFETY.
3. IN ADDITION TO THE SCHEDULING REQUIREMENTS IN THE GENERAL PROVISIONS, UPON REQUEST THE CONTRACTOR SHALL ALSO SUBMIT TO THE FLOCK SAFETY PROJECT SUPERVISOR, DAILY CREW ASSIGNMENT REPORTS SPECIFYING CREW AND CREW COMPOSITION AND WORK LOCATION.

PERMITS

1. FLOCK SAFETY HAS OBTAINED OR WILL OBTAIN PERMITS FROM DEPARTMENTS AND/OR AGENCIES OF CITIES, COUNTIES, STATES, FEDERAL GOVERNMENT, RAILROAD OR OTHER ENTITIES, WHICH PROVIDE FOR THE PLACING OF PIPES AND/OR CABLE UNDER DITCH, TRACKS AND ROADS AND PLACING PIPES AND/OR CABLE ALONG AND WITHIN PUBLIC OR PRIVATE ROAD RIGHTS OF WAY AND RAILROAD RIGHTS.
2. CONTRACTOR SHALL OBTAIN ADDITIONAL PERMITS, IF REQUIRED, FOR EQUIPMENT ACCESS OR MOVEMENT ON PUBLIC ROADS AND RAILROADS. COPIES OF SUCH PERMITS SHALL BE FURNISHED TO FLOCK SAFETY. ALL TRAFFIC CONTROL, IF APPLICABLE, SHALL BE IN ACCORDANCE WITH LOCAL, STATE, COUNTY, OR PERMITTING AGENCY LAWS, REGULATIONS, AND REQUIREMENTS, AND WILL BE THE CONTRACTOR'S RESPONSIBILITY. TRAFFIC CONTROL PLANS PROVIDED BY CURRENT NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DESIGN STANDARDS.

SCOPE OF WORK

1. THIS PROJECT SHALL CONSIST OF THE FOLLOWING OPERATIONS: THE WORK PACKAGE IS FOR THE INSTALLATION OF FLOCK SAFETY EQUIPMENT WHICH INCLUDES BUT IS NOT LIMITED TO: FLOCK SAFETY PROVIDED POLES, POLE MOUNTED SOLAR PANELS, AND EXTERNAL BATTERY PACKAGES.

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NEW HANOVER COUNTY SHERIFF'S OFFICE

230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA 28403

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
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FLOCK SAFETY EQUIPMENT INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

COVER SHEET & LOCATION MAPS

SHEET:	REV:
GN.01	0

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LOCATION DATA

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PROPOSED FLOCK EQUIPMENT ON PROPOSED FLOCK BREAKAWAY POLE

F#004 CASTLE HAYNE RD (HWY117) @ ORANGE ST SB

34.361242,-77.898974

6' FROM EDGE OF PAVEMENT

*REFERENCE TYPICAL DETAIL ON SHEET SPEC.01

1

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PROPOSED FLOCK EQUIPMENT ON PROPOSED FLOCK BREAKAWAY POLE

F#005 CASTLE HAYNE RD (HWY 133) @ DAVIS LN NB

34.310086,-77.921947

12' FROM EDGE OF PAVEMENT

*REFERENCE TYPICAL DETAIL ON SHEET SPEC.01

1

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PROPOSED FLOCK EQUIPMENT ON PROPOSED FLOCK BREAKAWAY POLE

F#013 RIVER RD @ SANDERS RD SB

34.124279,-77.915052

11' FROM FOG LINE

*REFERENCE TYPICAL DETAIL ON SHEET SPEC.01

1

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FLOCK SAFETY EQUIPMENT INSTALLATION

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SHEET:	REV:
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PROPOSED FLOCK EQUIPMENT ON PROPOSED FLOCK BREAKAWAY POLE

F#016 MILITARY CUTOFF RD @ NC140 NB

34.307598,-77.826727

13' FROM FOG LINE

*REFERENCE TYPICAL DETAIL ON SHEET SPEC.01

1

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A.04	0

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ALL CONSTRUCTION TO FOLLOW NORTH CAROLINA DEPARTMENT OF TRANSPORTATION GENERAL GUIDELINES. DO NOT SCALE DRAWINGS. CALL 811 PRIOR TO DIGGING.

PROPOSED FLOCK EQUIPMENT ON PROPOSED FLOCK BREAKAWAY POLE

P#012 GORDON RD @ MARKET ST WB

34.262977,-77.830084

10' FROM EDGE OF PAVEMENT

*REFERENCE TYPICAL DETAIL ON SHEET SPEC.01

1

[THIS SPACE LEFT INTENTIONALLY BLANK FOR STAMP]

NEW HANOVER COUNTY SHERIFF'S OFFICE

230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA 28403

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
-	-	-	-
3	06/11/2025	MPH	STAMPED SPECS
2	05/28/2025	MPH	REVISIONS
1	04/22/2025	RMD	REVISIONS
0	03/05/2025	MPH	PRELIM

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FLOCK SAFETY EQUIPMENT INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

COVER SHEET & LOCATION MAPS

SHEET:	REV:
A.05	0

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ALL CONSTRUCTION TO FOLLOW NORTH CAROLINA DEPARTMENT OF TRANSPORTATION GENERAL GUIDELINES. DO NOT SCALE DRAWINGS. CALL 811 PRIOR TO DIGGING.

PROPOSED FLOCK EQUIPMENT ON PROPOSED FLOCK BREAKAWAY POLE

P#013 CAROLINA BEACH RD (US421) @ PILOTS RIDGE RD SB

34.105110,-77.899849

13' FROM FOG LINE

*REFERENCE TYPICAL DETAIL ON SHEET SPEC.01

1

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NEW HANOVER COUNTY SHERIFF'S OFFICE

230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA 28403

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

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FLOCK SAFETY EQUIPMENT INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

COVER SHEET & LOCATION MAPS

SHEET:	REV:
A.06	0

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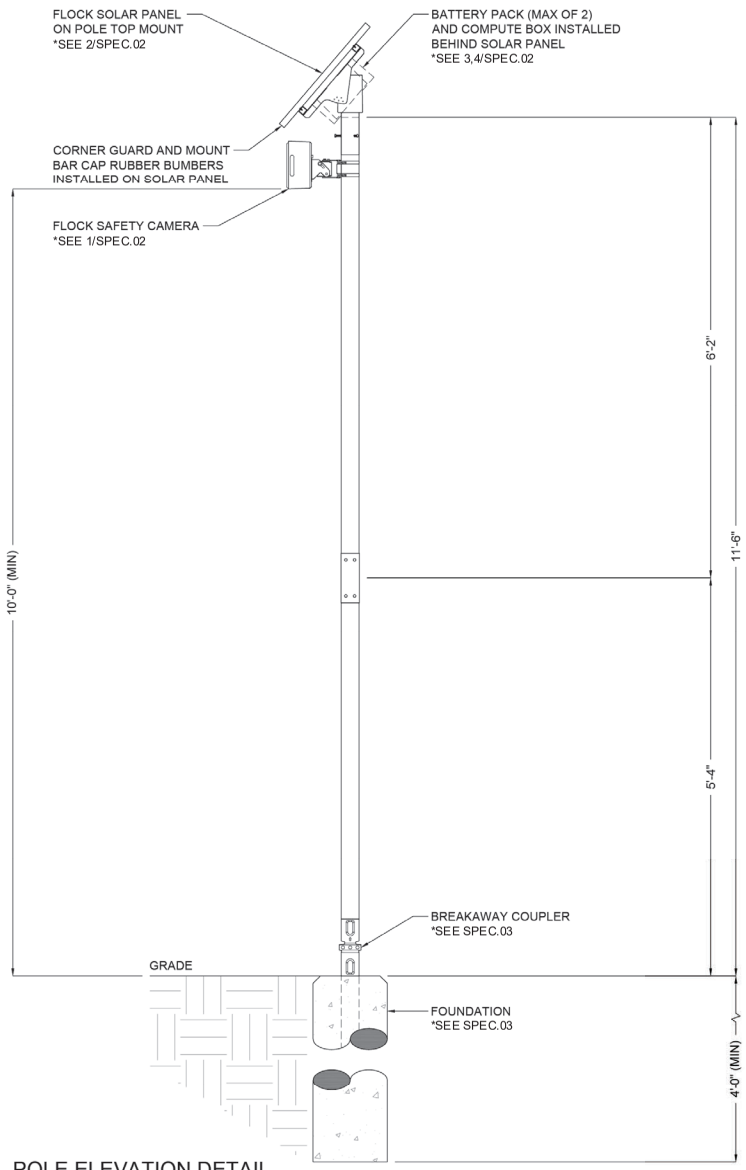

1 POLE ELEVATION DETAIL
SCALE: 1:20

DESIGN NOTES

1. POLE AND FOUNDATIONS ARE DESIGNED IN ACCORDANCE WITH THE FOLLOWING CODES:
   1.1. 2009/2012/2015/2018/2021 INTERNATIONAL BUILDING CODE
   1.2. AASHTO LRFD SPECIFICATIONS FOR STRUCTURAL SUPPORT FOR HIGHWAY SIGNS, LUMIN, TRAFFIC SIGNALS, 2015 EDITION.
2. POLE ANALYSIS AND FOUNDATION DESIGN ARE BASED ON THE FOLLOWINGCRITERIA
   2.1. DESIGN WIND SPEED (Vult)): (SEE SECTION 2.6)
   2.2. RISK CATEGORY: II
   2.3. EXPOSURE CATEGORY: C
   2.4. TOPOGRAPHIC CATEGORY: 1
   2.5. SEISMIC DESIGN CRITERIA:
      2.5.1. SOIL SITE CLASS: D (ASSUMED)
      2.5.2. SPECTRAL RESPONSE, Ss: 1.000g (MAXIMUM)
      2.5.3. SPECTRAL RESPONSE, S1: 0.400G (MAXIMUM)
      2.5.4. SEISMIC DESIGN CATEGORY: B
   2.6. STRUCTURE BASE REACTIONS ARE CALCULATED AS FOLLOWS:

DESIGN WIND SPEED (MPH)	MOMENT (K-FT)	SHEAR (KIP)	AXIAL (KIP)
115	2.70	0.280	0.160
125	3.20	0.330	0.160
135 (MAX)	3.70	0.380	0.160

   2.7. SHOULD ANY OF THE SITE-SPECIFIC PARAMETERS BE HIGHER THAN WHAT IS NOTED ABOVE, THE EOR SHALL BE CONTACTED TO PROVIDE A REVISED DESIGN.
3. CONTRACTOR IS RESPONSIBLE FOR VERIFYING SOIL CONDITIONS PRIOR TO INSTALLATION.
4. FOUNDATION TO CONSIST OF CONCRETE SURROUNDING THE PROPSED POLE WITH A MINMUM OF 3,000-PSI COMPRESSIVE STRENGTH.
5. ASSUMED SOIL PARAMETERS FOR THIS DESIGN ARE AS FOLLOWS:

UNIT WEIGHT	FRICTION ANGLE	COHESION	DEPTH TO GROUNDWATER
110 pcf	30 deg	0 psf	> 10 ft

IF THE ASSUMED SOIL PARAMETERS, ASSUMED GROUND WATER TABLE ELEVATION, OR ASSUMED STANDARD POLE DESIGN ARE NOT APPLICABLE, A SITE SPECIFIC FOUNDATION DESIGN WILL BE REQUIRED.

GENERAL & CONSTRUCTION NOTES

1. CONTRACTOR SHALL CONTACT DESIGNATED AGENCY TO LOCATE ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
2. CONTRACTOR SHALL APPLY AND OBTAIN AN APPROVED TRAFFIC CONTROL PLAN IN ACCORDANCE WITH MUTCD AND LOCAL JURISDICTION STANDARDS.
3. CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO ORIGINAL SITE CONDITION TO THE SATISFACTION OF STATE DEPARTMENT OF TRANSPORTATION AND LOCAL JURISDICTION.
4. ALL WORK SHALL CONFORM TO APPLICABLE ELECTRICAL CODES EXCEPT WHEN STATE DEPARTMENT OF TRANSPORTATION OR LOCAL JURISDICTION STANDARDS SUPERSEDE.
5. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPECIFICATIONS DEFINED BY THE STATE DEPARTMENT OF TRANSPORTATION OR LOCAL JURISDICTION, UNLESS SPECIFICALLY STATED OR SHOWN OTHERWISE HEREIN.

ADA COMPLIANCE NOTES

1. ALL SIDEWALK CONSTRUCTION SHALL BE IN ACCORDANCE WITH ADA TITLE II, STATE DEPARTMENT OF TRANSPORTATION, AND LOCAL JURISDICTION STANDARDS,
2. STATE DEPARTMENT OF TRANSPORTATION CURRENT EDITION STANDARDS SHALL BE USED FOR PEDESTRIAN CONTROL PLANS WHEN CLOSURE OF SIDEWALK IS REQUIRED FOR CONSTRUCTION.
3. MINIMUM CLEAR PEDESTRIAN ACCESS ROUTE (PAR) SHALL BE 48" WIDE.
4. NO OBSTRUCTION IS PERMITTED ALONG THE WIDTH OF THE SIDEWALK. UP TO AN ELEVATION OD 7'-0" ABOVE GRADE.

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
Date: 06/04/2025
Reviewed
Transportation Mobility and Safety Division

TYPICAL DETAIL

FLOCK SAFETY CAMERA ON BREAKAWAY COUPLER POLE

flock safety
1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
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1	04/22/2025	RMD	REVISIONS
0	03/05/2025	MPH	PRELIM

Digitally signed by Michael B Leeper
Date: 2025.05.21 12:20:13-07'00'

NORTH CAROLINA PROFESSIONAL SEAL 47119 ENGINEER MICHAEL B. LEEPER
5/21/2025

FLOCK SAFETY EQUIPMENT INSTALLATION

TYPICAL DETAILS	
SHEET: SPEC.01	REV: 0

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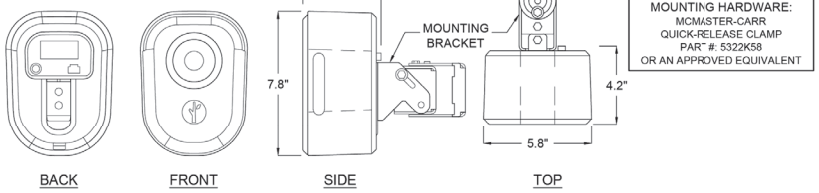
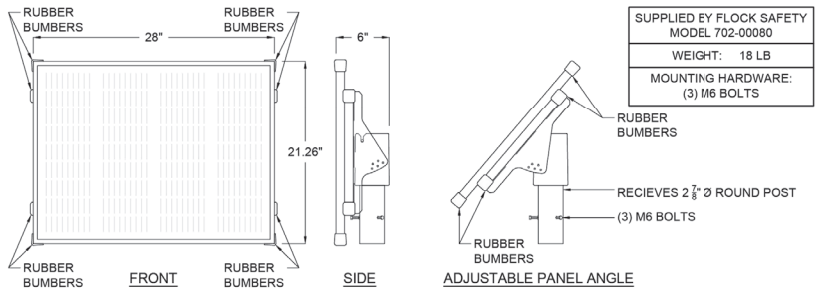


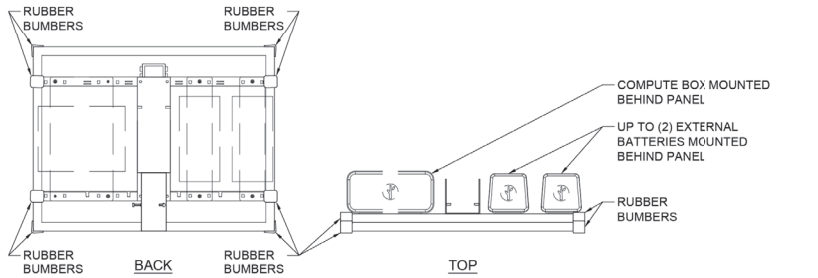
SUPPLIED EY FLOCK SAFETY MODEL 706-0002
WEIGHT: 3.5 LB
MOUNTING HARDWARE: MCMASTER-CARR QUICK-RELEASE CLAMP PAR" #: 5322K58 OR AN APPROVED EQUIVALENT

1 FLOCK SAFETY CAMERA

SCALE: N/A

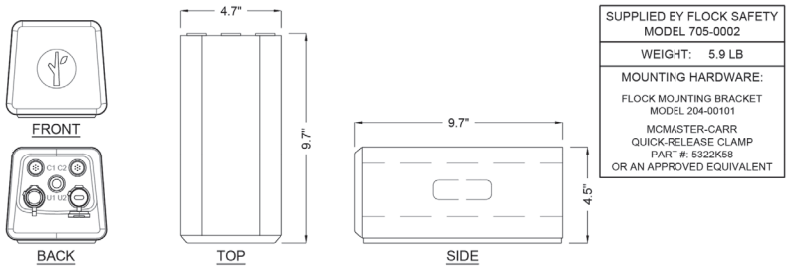


SUPPLIED EY FLOCK SAFETY MODEL 702-00080
WEIGHT: 18 LB
MOUNTING HARDWARE: (3) M6 BOLTS



2 65 WATT SOLAR PANEL AND MOUNT ASSEMBLY (TOP MOUNTED)

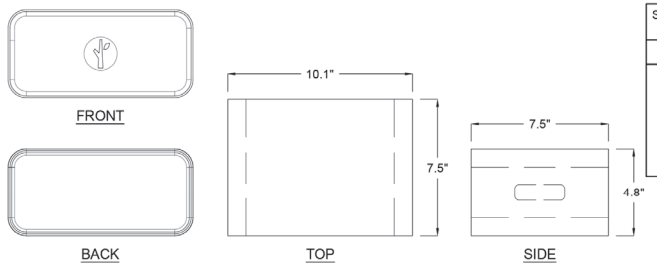
SCALE: N/A



SUPPLIED EY FLOCK SAFETY MODEL 705-0002
WEIGHT: 5.9 LB
MOUNTING HARDWARE: FLOCK MOJNTING BRACKET MODEL 204-00101 MCMASTER-CARR QUICK-RELEASE CLAMP PART #: 5322K68 OR AN APPROVED EQUIVALENT

3 FLOCK EXTERNAL BATTERY

SCALE: N/A



SUPPLIED BY FLOCK SAFETY MODEL 705-0002
WEIGHT: 4.6 LB
MOUNTING HARDWARE: FLOCK MOUNTING BRACKET MODEL 204-00102 MCMASTER-CARR QUICK-RELEASE CLAMP PART #: 5322K58 OR AN APPROVED EQUIVALENT

4 FLOCK COMPUTE BOX

SCALE: N/A

TYPICAL DETAIL

FLOCK SAFETY CAMERA ON BREAKAWAY COUPLER POLE

flock safety
1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
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0	03/05/2025	MPH	PRELIM

5/21/2025

FLOCK SAFETY EQUIPMENT INSTALLATION

TYPICAL DETAILS	
SHEET: SPEC.02	REV: 0

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ITEM NO.	DESCRIPTION	QTY.
1	0.250-20 X 0.750 BT TX TAMPER-RESISTANT	6
2	2" SCH 40 2.375OD 0.154WALL - GALVANIZED STEEL	1
3	2.875OD X 0.203 WALL X 33.000L - 6061-T6 ALUMINUM	1
4	2.875OD X 0.203 WALL X 60.875L - 6061-T6 ALUMINUM	1
5	2.875OD X 0.203 WALL X 74.000L - 6063-T52 ALUMINUM	1
6	BRAIDED SLEEVE	1
7	DESIGNOVATIONS BREAKAWAY ROUND POST 2.875OD MODEL S300R	1
8	CONCRETE FOOTING	1
9	HBOLT ANTI ROTATION	1
10	INSERT SLEEVE STYLE 7 TAPPED	1
11	ORING SQ	1
12	WASHER 0.250 SPLIT LOCK 0.260 X 0.487 X 0.062	6
13	BOLT 0.250-20 X 3.500 X 0.750 HX BLACK WITH NUT 0.250-20 HX BLACK	1

PROVELI MASH DETAILS

BREAKAWAY STYLE 7 COUPLER ASSEMBLY

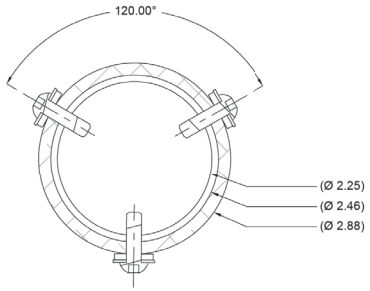
PART #: SP-7/MASH

MATERIAL: VARIES

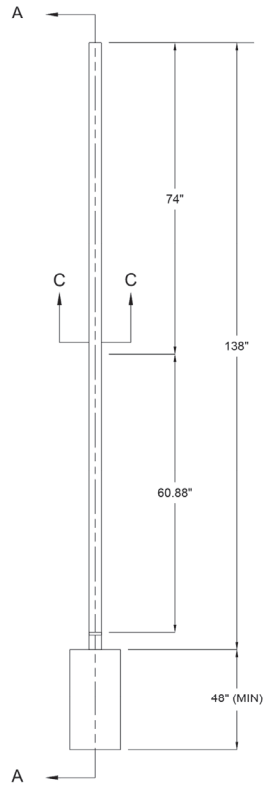
WEIGHT: 224.84 LBS

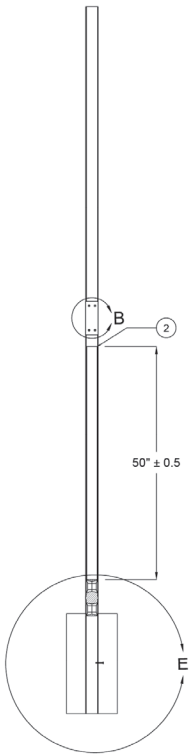
DATE: 01/11/2024

DO NOT SCALE DRAWINGS (NTS)

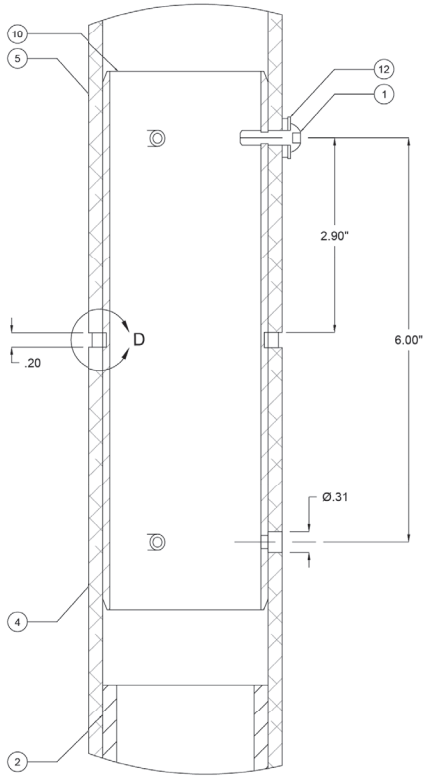


SECTION C-C

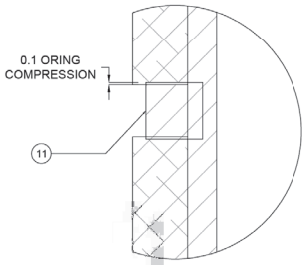




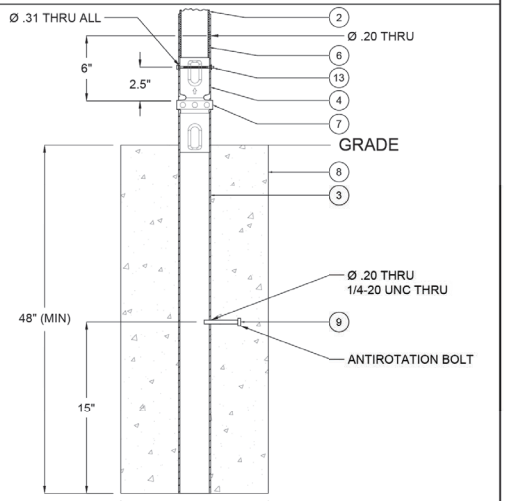
SECTION A-A



DETAIL B



DETAIL D



DETAIL E

NOTE: CONCRETE SHALL HAVE A MINIMUM COMPRESIVE STRENGTH OF 3,000 PSI.

TYPICAL DETAIL

FLOCK SAFETY CAMERA ON BREAKAWAY COUPLER POLE

flock safety
1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
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FLOCK SAFETY EQUIPMENT INSTALLATION

TYPICAL DETAILS	
SHEET: SPEC.03	REV: 0

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GENERAL TCP NOTES & TABLES

GENERAL NOTES

1. ALL WORK AND MATERIALS SHALL COMPLY WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) AND NORTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARDS.
2. ALL STRIPING AND MARKINGS SHALL CONFORM TO THE STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD PLANS AND STANDARD SPECIFICATIONS.
3. TRAFFIC CONES SHALL NOT INTERFERE WITH EXISTING DRIVEWAYS, SCHOOL ZONES, OR BUS STOPS.
4. ALL TEMPORARY TRAVEL LANES SHALL BE A MINIMUM OF 10' WIDE.
5. FLASHING YELLOW BEACONS, TYPE "B", SHALL BE USED ON ALL W20-1 SIGNS AND ON ALL TYPE III BARRICADES GUARDING THE WORK OVERNIGHT.
6. ALL SIGNS SHALL BE REFLECTORIZED AND STANDARD SIZE.
7. ALL TUBULAR DELINEATORS AND CONES SHALL BE 28" MINIMUM HEIGHT, REFLECTORIZED AND MAINTAINED ERECT IN THE INDICATED POSITION AT ALL TIMES, AND SHALL BE REPAIRED, REPLACED, OR CLEANED AS NECESSARY TO PRESERVE THEIR APPEARANCE AND CONTINUITY, AND SHALL INCLUDE A 12" HIGH-INTENSITY REFLECTORIZED SLEEVE..
8. THE CONTRACTOR SHALL MAINTAIN, ON A CONTINUOUS BASIS, ALL SIGNS, DELINEATORS, BARRICADES, ETC., TO ENSURE PROPER FLOW AND SAFETY OF TRAFFIC DURING CONSTRUCTION.
9. THE CONTRACTOR SHALL HAVE SIGNS, DELINEATORS, BARRICADES, ETC., PROPERLY INSTALLED PRIOR TO COMMENCING CONSTRUCTION.
10. CONSTRUCTION OPERATIONS SHALL BE CONDUCTED IN SUCH A MANNER AS TO CAUSE AS LITTLE INCONVENIENCE AS POSSIBLE TO ABUTTING PROPERTY OWNERS.
11. ADDITIONAL TRAFFIC CONTROLS, TRAFFIC SIGNS OR BARRICADING MAY BE REQUIRED IN THE FIELD. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PLACEMENT OF ANY ADDITIONAL DEVICES NECESSARY TO ASSURE THE SAFETY TO THE PUBLIC AT ALL TIMES DURING CONSTRUCTION.
12. SIDEWALK CLOSED SIGNS ARE TO BE PRESENT ANYTIME A PEDESTRIAN WALKWAY IS CLOSED.
13. WHERE IT HAS BEEN DETERMINED THAT THE ACCOMMODATION OF PEDESTRIANS WITH DISABILITIES IS NECESSARY, SIGNS SHALL BE MOUNTED AND PLACED IN ACCORDANCE WITH SECTION 4.4 OF THE "AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES (ADAAG)"
14. EXACT LOCATION AND TYPE OF CONSTRUCTION SIGNS SHALL BE DIRECTED BY THE CONTRACTOR BASED UPON CONSTRUCTION CONDITIONS.
15. MOVE DELINEATORS AND/OR CONES TO SIDEWALK DURING NON-WORKING HOURS. REMOVE BARRICADES ETC., FROM TRAVEL LANE.
16. REMOVE OR TURN OFF SIGNS DURING NON-WORKING HOURS.
17. ALL CONFLICTING LINES, EXISTING CURB PAINT, AND MARKINGS SHALL BE REMOVED BY WET SANDBLASTING OR OTHER APPROVED METHOD PRIOR TO INSTALLATION OF NEW/TEMPORARY STRIPING. ALL CONFLICTING RAISED PAVEMENT MARKERS SHALL BE REMOVED. PAVEMENT THAT IS DAMAGED DUE TO REMOVAL OF MARKERS SHALL BE REPAIRED TO THE SATISFACTION OF THE CITY ENGINEER AND/OR STATE INSPECTOR.
18. DIMENSIONS BASED ON RECORD DRAWINGS AND NOT A SURVEY.
19. TIME OF LANE CLOSURE TO BE IN ACCORDANCE WITH REQUIREMENTS OF JURISDICTION.
20. ADDITIONAL ADVANCED FLAGGERS MAY BE REQUIRED. FLAGGER SHOULD STAND IN A CONSPICUOUS PLACE, BE VISIBLE TO APPROACHING TRAFFIC. PLACE A MINIMUM OF FOUR CONES AT 40-FT INTERVAL IN ADVANCE OF FLAGGER STATION AS SHOWN.
21. TABLES AND SIGNAGE DISPLAYED SHALL COMPLY WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) CHAPTER 6.

TABLE 6C-1. RECOMMENDED ADVANCE WARNING SIGN MINIMUM SPACING

ROAD TYPE	DISTANCE BETWEEN SIGNS** (FT)		
	A	B	C
URBAN (LOW SPEED)*	100	100	100
URBAN (HIGH SPEED)*	350	350	350
RURAL	500	500	500
EXPRESSWAY / FREEWAY	1000	1500	2640

* SPEED CATEGORY TO BE DETERMINED BY HIGHWAY AGENCY
** THE COLUMN HEADING A,B AND C ARE THE DIMENSION SHOWN IN FIGURES 6H-1 THROUGH 6H-46 IN CHAPTER 6H OF THE MUTCD. THE A DIMENSION IS THE DISTANCE FROM THE TRANSITION OR POINT OF RESTRICTION TO THE FIRST SIGNS. THE B DIMENSION IS THE DISTANCE BETWEEN THE FIRST AND SECOND SIGNS.THE C DIMENSION IS THE DISTANCE BETWEEN THE SECOND AND THIRD SIGNS. (THE "FIRST SIGN" IS THE SIGN IN A THREE-SIGN SERIES THAT IS CLOSEST TO THE TTC ZONE. THE "THIRD SIGN" IS THE SIGN THAT IS FURTHEST UPSTREAM FROM THE TTC ZONE.)

TABLE 6C-2. STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED

SPEED (MPH)	DISTANCE (FT)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730

* POSTED SPEED, OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED

TABLE 6C-3. TAPER LENGTH CRITERIA FOR TEMPORARY TRAFFIC CONTROL ZONES

TYPE OF TAPER	TAPER LENGTH
MERGING TAPER	AT LEAST L
SHIFTING TAPER	AT LEAST 0.5 L
SHOULDER TAPER	AT LEAST 0.33 L
ONE-LANE, TWO-WAY TRAFFIC TAPER	50 FT MINIMUM, 100 FT MAXIMUM
DOWNSTREAM TAPER	50 FT MINIMUM, 100 FT MAXIMUM

NOTE: USE TABLE 6C-4 TO CALCULATE L

TABLE 6C-3. TAPER LENGTH CRITERIA FOR TEMPORARY TRAFFIC CONTROL ZONES

SPEED (S)	TAPER LENGTH (L) IN FEET(FT)
40 MPH OR LESS	$L = WS^2/60$
45 MPH OR MORE	$L = WS$

WHERE: L = TAPER LENGTH IN FT W= WIDTH OF OFFSET IN FT
S= POSTED SPEED LIMIT, OR OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED IN MPH

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LICENSE PLATE READER CAMERA INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

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NEW HANOVER COUNTY SHERIFF'S OFFICE
230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA
28403

COVER SHEET & LOCATION MAPS

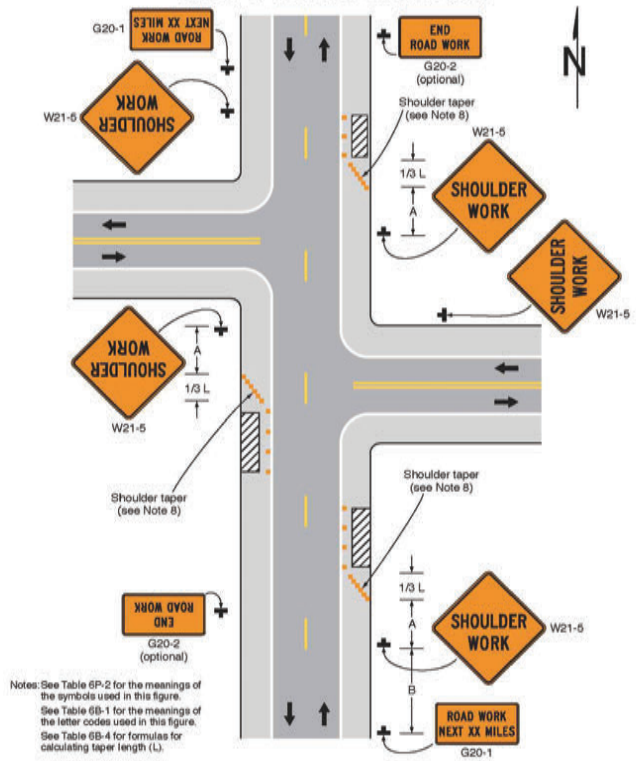
SHEET:	REV:
TCP.01	0

THIS DOCUMENT HAS BEEN DRAWN BASED OFF THE MOST RECENT AVAILABLE DATA & AERIAL IMAGERY. THIS INCLUDES RIGHT OF WAY, EXISTING UTILITIES, & PRIVATE PROPERTY LINES. IT REMAINS THE RESPONSIBILITY OF OTHERS TO VERIFY ALL DATA PRIOR AND EXISTING SURRONDING FACILITIES TO VERIFY & CONFLICTS ABOVE & BELOW GRADE. ALL CONSTRUCTION TO FOLLOW NORTH CAROLINA DEPARTMENT OF TRANSPORTATION GENERAL GUIDELINES. DO NOT SCALE DRAWINGS. CALL 811 PRIOR TO DIGGING.

1

MUTCD 11th Edition Page 865

Figure 6P-3. Work on the Shoulders (TA-3)



Notes: See Table 6P-2 for the meanings of the symbols used in this figure.
See Table 6B-1 for the meanings of the letter codes used in this figure.
See Table 6B-4 for formulas for calculating taper length (L).

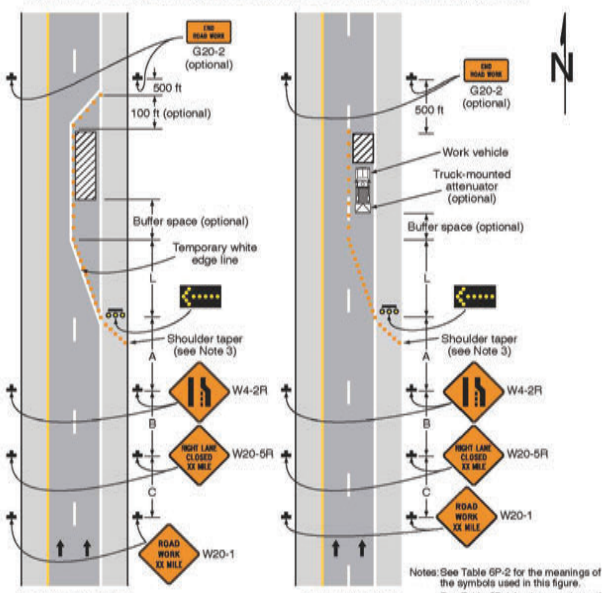
Typical Application 3

December 2023 Sect. 6P.01

2

MUTCD 11th Edition Page 925

Figure 6P-33. Stationary Lane Closure on a Divided Highway (TA-33)



Notes: See Table 6P-2 for the meanings of the symbols used in this figure.
See Table 6B-1 for the meanings of the letter codes used in this figure.
See Table 6B-4 for formulas for calculating taper length (L).

Typical Application 33

December 2023 Sect. 6P.01

LICENSE PLATE READER CAMERA INSTALLATION

CASE NUMBER: 972582
PERMITTING JURISDICTION:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

[THIS SPACE LEFT INTENTIONALLY BLANK FOR STAMP]

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

[THIS SPACE LEFT INTENTIONALLY BLANK FOR STAMP]

REV	DATE	BY	DESCRIPTION
-	-	-	-
3	06/11/2025	MPH	STAMPED SPECS
2	05/28/2025	MPH	REVISIONS
1	04/22/2025	RMD	REVISIONS
0	03/05/2025	MPH	PRELIM

I HEARBY CERTIFY THIS DOCUMENT WAS PREPARED BY MYSELF OR UNDER MY DIRECT SUPERVISION THAT I AM A DULY REGISTERED ENGINEER UNDER THE LAWS OF THE STATE OF NORTH CAROLINA.

NEW HANOVER COUNTY SHERIFF'S OFFICE
230 GOVERNMENT CENTER DR
WILMINGTON, NORTH CAROLINA
28403

COVER SHEET & LOCATION MAPS

SHEET:	REV:
TCP.02	0

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Structural Analysis
Flock Safety

April 3, 2025

Site Name	NCDOT BREAKAWAY COUPLER POLE_SOLAR_1 PICARD
Client	Flock Safety
Site Location	North Carolina
Structure Type	Proveli Pole
Overall Result	**Pass**
Required Modification	-

Upon reviewing the results of this analysis, it is our opinion that the structure does meet the specified AASHTO code requirements. The proveli is therefore deemed adequate to support the existing and proposed loading as listed in this report.

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
Date: 04/10/2025
Reviewed
Transportation Mobility and Safety Division

Digitally signed by Michael B Leeper
Date: 2025.04.03 17:55:26-07'00'

NORTH CAROLINA PROFESSIONAL SEAL 47119 ENGINEER MICHAEL B. LEEPER

4/3/2025

8605 Santa Monica Blvd. #73703, West Hollywood, CA 90069

Texas A&M Transportation Institute
PROVING GROUND

Test Report No. 690900-PVL5-7

MASH TL-3 EVALUATION OF PROVELI BREAKAWAY POLE SYSTEM

Sponsored by
Proveli

TEXAS A&M TRANSPORTATION INSTITUTE PROVING GROUND
Roadside Safety & Physical Security
Texas A&M University System RELLIS Campus
Building 7091
1254 Avenue A
Bryan, TX 77807

A2LA ACCREDITED
ISO 17025 Laboratory Testing Certificate # 2821.01

Technical Report Documentation Page

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Nathan D. Schulz, and Brianna E. Bastin	TRNo. 690900-PVL5-7
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Proveli 4495 W Vernal Pike Bloomington, IN 47404	Technical Report: September 2024 - December 2024
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15. Supplementary Notes

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16. Abstract

The purpose of the tests reported herein was to assess the performance of the Proveli Breakaway Pole System according to the safety-performance evaluation guidelines included in the second edition of the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (*MASH*) (*1*). The crash tests were performed in accordance with *MASH* Test Level 3 (TL-3):

1. ***MASH* Test 3-60:** An 1100C vehicle weighing 2420 lb impacting the Support Structures while travelling at 19 mi/h and 0 degrees.
2. ***MASH* Test 3-61:** A 1100C vehicle weighing 2420 lb impacting the Support Structures while traveling at 62 mi/h and 0 degrees.
3. ***MASH* Test 3-62:** A 2270P vehicle weighing 5000 lb impacting the Support Structures while traveling at 62 mi/h and 0 degrees.

This report provides details on the Proveli Breakaway Pole System, the crash tests and results, and the performance assessment of the Proveli Breakaway Pole System for *MASH* TL-3 Support Structures evaluation criteria.

The Proveli Breakaway Pole System met the performance criteria for *MASH* TL-3 Support Structures.

17. Key Words	18. Distribution Statement
Support Structure, Pole, Breakaway, Crash Test, MASH, Occupant Risk, Penetration	Copyrighted. Not to be copied or reprinted without consent from Proveli.

19. Security Classification. (of this report)	20. Security Classification. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	98	

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MASH TL-3 Evaluation of Proveli Breakaway Pole System

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Report 690900-PVL5-7
Contract No.: 2404645

Sponsored by

Proveli

December 2024

TEXAS A&M TRANSPORTATION INSTITUTE
College Station, Texas 77843-3135

DISCLAIMER

The contents of this report reflect the views of the authors, who are solely responsible for the facts and accuracy of the data and the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of Proveli, The Texas A&M University System, or the Texas A&M Transportation Institute (TTI). This report does not constitute a standard, specification, or regulation. In addition, the above listed agencies/companies assume no liability for its contents or use thereof. The names of specific products or manufacturers listed herein do not imply endorsement of those products or manufacturers.

The results reported herein apply only to the article tested. The full-scale crash tests were performed according to TTI Proving Ground quality procedures and American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware, Second Edition (*MASH*) guidelines and standards.

The Proving Ground Laboratory within TTI's Roadside Safety and Physical Security Division ("TTI Lab") strives for accuracy and completeness in its crash test reports. On rare occasions, unintentional or inadvertent clerical errors, technical errors, omissions, oversights, or misunderstandings (collectively referred to as "errors") may occur and may not be identified for corrective action prior to the final report being published and issued. If, and when, the TTI Lab discovers an error in a published and issued final report, the TTI Lab will promptly disclose such error to Proveli, and both parties shall endeavor in good faith to resolve this situation. The TTI Lab will be responsible for correcting the error that occurred in the report, which may be in the form of errata, amendment, replacement sections, or up to and including full reissuance of the report. The cost of correcting an error in the report shall be borne by the TTI Lab. Any such errors or inadvertent delays that occur in connection with the performance of the related testing contract will not constitute a breach of the testing contract.

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REVISION LOG

Revision Number	Change(s) Made	Date

TABLE OF CONTENTS

Page

Chapter 1. Introduction 1
Chapter 2. System Details 3
2.1. Test Article and Installation Details 3
2.2. Design Modifications during Tests 3
2.3. Material Specifications 8
Chapter 3. Test Requirements and Evaluation Criteria 9
3.1. Crash Test Performed/Matrix 9
3.2. Evaluation Criteria 9
Chapter 4. Test Conditions 11
4.1. Test Facility 11
4.2. Vehicle Tow and Guidance System 11
4.3. Data Acquisition Systems 12
4.3.1. Vehicle Instrumentation and Data Processing 12
4.3.2. Anthropomorphic Dummy Instrumentation 13
4.3.3. Photographic Instrumentation Data Processing 13
Chapter 5. MASH Test 3-60 (Crash Test 690900-PVL-5) 15
5.1. Critical Impact Point Location 15
5.2. Test Vehicle Details Prior to Impact 17
5.3. Test Description 19
5.3.1. Weather Conditions 19
5.3.2. Test Events 19
5.4. Test Actual Impact Conditions 20
5.5. Damage to Test Installation 20
5.6. Damage to Test Vehicle 22
5.7. Occupant Risk Factors 25
5.8. Test Summary 25
Chapter 6. MASH Test 3-61 (Crash Test 690900-PVL-6) 27
6.1. Critical Impact Point Location 27
6.2. Test Vehicle Details Prior to Impact 29
6.3. Test Description 31
6.3.1. Weather Conditions 31
6.3.2. Test Events 31
6.4. Test Actual Impact Conditions 32
6.5. Damage to Test Installation 32
6.6. Damage to Test Vehicle 34
6.7. Occupant Risk Factors 37
6.8. Test Summary 37
Chapter 7. MASH Test 3-62 (Crash Test 690900-PVL-7) 39

7.1. Critical Impact Point Location 39
7.2. Test Vehicle Details Prior to Impact 41
7.3. Test Description 43
7.3.1. Weather Conditions 43
7.3.2. Test Events 43
7.4. Test Actual Impact Conditions 44
7.5. Damage to Test Installation 44
7.6. Damage to Test Vehicle 46
7.7. Occupant Risk Factors 49
7.8. Test Summary 49
Chapter 8. Summary and Conclusions 51
References 53
Appendix A. Details of Proveli Breakaway Pole System 55
Appendix B. Supporting Certification Documents 59
Appendix C. MASH Test 3-60 (Crash Test 690900-PVL-5) 63
C.1. Vehicle Properties and Information 63
C.2. Sequential Photographs 66
C.3. Vehicle Angular Displacements 68
C.4. Vehicle Accelerations 70
Appendix D. MASH Test 3-61 (Crash Test 690900-PVL-6) 75
D.1. Vehicle Properties and Information 75
D.2. Sequential Photographs 78
D.3. Vehicle Angular Displacements 80
D.4. Vehicle Accelerations 82
Appendix E. MASH Test 3-62 (Crash Test 690900-PVL-7) 87
E.1. Vehicle Properties and Information 87
E.2. Sequential Photographs 90
E.3. Vehicle Angular Displacements 92
E.4. Vehicle Accelerations 94

LIST OF FIGURES

Page
Figure 2.1. Details of Proveli Breakaway Pole System. 4
Figure 2.2. Proveli Breakaway Pole System prior to Testing. 5
Figure 2.3. Lower Portion of the Proveli Breakaway Pole System prior to Testing. 5
Figure 2.4. Base of the Proveli Breakaway Pole System prior to Testing. 6
Figure 2.5. Joint of the Upper and Lower Portions of the Proveli Breakaway Pole System prior to Testing. 6
Figure 2.6. Proveli Breakaway Pole and Flock Safety Solar Panel and Camera prior to Testing. 7
Figure 2.7. Rear of the Proveli Breakaway Pole and Flock Safety Solar Panel prior to Testing. 7
Figure 5.1. Target CIP for *MASH* Test 3-60 on Proveli Breakaway Pole System. 15
Figure 5.2. Proveli Breakaway Pole System/Test Vehicle Geometrics for Test 690900-PVL-5. 16
Figure 5.3. Proveli Breakaway Pole System/Test Vehicle Impact Location for Test 690900-PVL-5. 16
Figure 5.4. Front of Test Vehicle before Test 690900-PVL-5 18
Figure 5.5. Rear of Test Vehicle before Test 690900-PVL-5. 18
Figure 5.6. Proveli Breakaway Pole System Base at Impact Location after Test 690900-PVL-5. 21
Figure 5.7. Proveli Breakaway Pole System after Test 690900-PVL-5. 21
Figure 5.8. Front of Test Vehicle after Test 690900-PVL-5. 22
Figure 5.9. Rear of Test Vehicle after Test 690900-PVL-5. 22
Figure 5.10. Overall Interior of Test Vehicle after Test 690900-PVL-5. 23
Figure 5.11. Windshield of Test Vehicle after Test 690900-PVL-5. 23
Figure 5.12. Summary of Results for MASH Test 3-60 on Provli Breakaway Pole System. 26
Figure 6.1. Target CIP for *MASH* Test 3-61 on Proveli Breakaway Pole System. 27
Figure 6.2. Proveli Breakaway Pole System/Test Vehicle Geometrics for Test 690900-PVL-6. 28
Figure 6.3. Proveli Breakaway Pole System/Test Vehicle Impact Location for Test 690900-PVL-6. 28
Figure 6.4. Front of Test Vehicle before Test 690900-PVL-6 30
Figure 6.5. Rear of Test Vehicle before Test 690900-PVL-6. 30
Figure 6.6. Proveli Breakaway Pole System Base at Impact Location after Test 690900-PVL-6. 33
Figure 6.7. Proveli Breakaway Pole System after Test 690900-PVL-6. 33
Figure 6.8. Impact Side of Test Vehicle after Test 690900-PVL-6. 34
Figure 6.9. Rear of Test Vehicle after Test 690900-PVL-6. 34
Figure 6.10. Overall Interior of Test Vehicle after Test 690900-PVL-6. 35

Figure 6.11. Windshield after Test 690900-PVL-6. 35
Figure 6.12. Summary of Results for MASH Test 3-61 on Proveli Breakaway Pole System. 38
Figure 7.1. Target CIP for *MASH* Test 3-62 on Proveli Breakaway Pole System. 39
Figure 7.2. Proveli Breakaway Pole System/Test Vehicle Geometrics for Test 690900-PVL-7. 40
Figure 7.3. Proveli Breakaway Pole System/Test Vehicle Impact Location for Test 690900-PVL-7. 40
Figure 7.4. Front of Test Vehicle before Test 690900-PVL-7. 42
Figure 7.5. Rear of Test Vehicle before Test 690900-PVL-7. 42
Figure 7.6. Proveli Breakaway Pole System Base at Impact Location after Test 690900-PVL-7. 45
Figure 7.7. Proveli Breakaway Pole System after Test 690900-PVL-7. 45
Figure 7.8. Front of Test Vehicle after Test 690900-PVL-7. 46
Figure 7.9. Test Vehicle Roof after Test 690900-PVL-7. 46
Figure 7.10. Overall Interior of Test Vehicle after Test 690900-PVL-7. 47
Figure 7.11. Windshield Damage after Test 690900-PVL-7. 47
Figure 7.12. Summary of Results for MASH Test 3-62 on Proveli Breakaway Pole System. 50
Figure C.1. Vehicle Properties for Test 690900-PVL-5. 63
Figure C.2. Exterior Crush Measurements for Test 690900-PVL-5. 64
Figure C.3. Occupant Compartment Measurements for Test 690900-PVL-5. 65
Figure C.4. Sequential Photographs for Test 690900-PVL-5 (Right Angle Views). 66
Figure C.5. Sequential Photographs for Test 690900-PVL-5 (Downstream Oblique Views). 67
Figure C.6. Vehicle Angular Displacements for Test 690900-PVL-5. 69
Figure C.7. Vehicle Longitudinal Accelerometer Trace for Test 690900-PVL-5 (Accelerometer Located at Center of Gravity). 71
Figure C.8. Vehicle Lateral Accelerometer Trace for Test 690900-PVL-5 (Accelerometer Located at Center of Gravity). 72
Figure C.9. Vehicle Vertical Accelerometer Trace for Test 690900-PVL-5 (Accelerometer Located at Center of Gravity). 73
Figure D.1. Vehicle Properties for Test 690900-PVL-6. 75
Figure D.2. Exterior Crush Measurements for Test 690900-PVL-6. 76
Figure D.3. Occupant Compartment Measurements for Test 690900-PVL-6. 77
Figure D.4. Sequential Photographs for Test 690900-PVL-6 (Right Angle Views). 78
Figure D.5. Sequential Photographs for Test 690900-PVL-6 (Downstream Oblique Views). 79
Figure D.6. Vehicle Angular Displacements for Test 690900-PVL-6. 81
Figure D.7. Vehicle Longitudinal Accelerometer Trace for Test 690900-PVL-6 (Accelerometer Located at Center of Gravity). 83
Figure D.8. Vehicle Lateral Accelerometer Trace for Test 690900-PVL-6 (Accelerometer Located at Center of Gravity). 84

Figure D.9. Vehicle Vertical Accelerometer Trace for Test 690900-PVL-6 (Accelerometer Located at Center of Gravity). 85
Figure E.1. Vehicle Properties for Test 690900-PVL-7. 87
Figure E.2. Exterior Crush Measurements for Test 690900-PVL-7. 88
Figure E.3. Occupant Compartment Measurements for Test 690900-PVL-7. 89
Figure E.4. Sequential Photographs for Test 690900-PVL-7 (Right Angle Views). 90
Figure E.5. Sequential Photographs for Test 690900-PVL-7 (Downstream Oblique Views). 91
Figure E.6. Vehicle Angular Displacements for Test 690900-PVL-7. 93
Figure E.7. Vehicle Longitudinal Accelerometer Trace for Test 690900-PVL-7 (Accelerometer Located at Center of Gravity). 95
Figure E.8. Vehicle Lateral Accelerometer Trace for Test 690900-PVL-7 (Accelerometer Located at Center of Gravity). 96
Figure E.9. Vehicle Vertical Accelerometer Trace for Test 690900-PVL-7 (Accelerometer Located at Center of Gravity). 97

LIST OF TABLES

Page
Table 2.1. Concrete Strength. 8
Table 3.1. Test Conditions and Evaluation Criteria Specified for *MASH* TL-3 Support Structures. 9
Table 3.2. Evaluation Criteria Required for *MASH* Testing. 10
Table 5.1. Vehicle Measurements for Test 690900-PVL-5. 17
Table 5.2. Weather Conditions for Test 690900-PVL-5. 19
Table 5.3. Events during Test 690900-PVL-5. 19
Table 5.4. Impact Conditions for *MASH Test 3-60,* Crash Test 690900-PVL-5. 20
Table 5.5. Exit Parameters for *MASH Test 3-60,* Crash Test 690900-PVL-5. 20
Table 5.6. Occupant Compartment Deformation for Test 690900-PVL-5. 24
Table 5.7. Exterior Vehicle Damage for Test 690900-PVL-5. 24
Table 5.8. Occupant Risk Factors for Test 690900-PVL-5. 25
Table 6.1. Vehicle Measurements for Test 690900-PVL-6. 29
Table 6.2. Weather Conditions for Test 690900-PVL-6. 31
Table 6.3. Events during Test 690900-PVL-6. 31
Table 6.4. Impact Conditions for *MASH Test 3-61,* Crash Test 690900-PVL-6. 32
Table 6.5. Exit Parameters for *MASH Test 3-61,* Crash Test 690900-PVL-6. 32
Table 6.6. Occupant Compartment Deformation for Test 690900-PVL-6. 36
Table 6.7. Exterior Vehicle Damage for Test 690900-PVL-6. 36
Table 6.8. Occupant Risk Factors for Test 690900-PVL-6. 37
Table 7.1. Vehicle Measurements for Test 690900-PVL-7. 41
Table 7.2. Weather Conditions for Test 690900-PVL-7. 43
Table 7.3. Events during Test 690900-PVL-7. 43
Table 7.4. Impact Conditions for *MASH TEST 3-62,* Crash Test 690900-PVL-7. 44
Table 7.5. Exit Parameters for *MASH TEST 3-62,* Crash Test 690900-PVL-7. 44
Table 7.6. Occupant Compartment Deformation for Test 690900-PVL-7. 48
Table 7.7. Exterior Vehicle Damage for Test 690900-PVL-7. 48
Table 7.8. Occupant Risk Factors for Test 690900-PVL-7. 49
Table 8.1. Assessment Summary for *MASH* TL-3 Tests on Proveli Breakaway Pole System. 51

SI* (MODERN METRIC) CONVERSION FACTORS				
APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5(F-32)/9 or (F-32)/1.8	Celsius	°C
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	Square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lb/in^2

*SI is the symbol for the International System of Units

CHAPTER 1.

INTRODUCTION

The purpose of the tests reported herein was to assess the performance of the Proveli Breakaway Pole System according to the safety-performance evaluation guidelines included in the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (*MASH*), Second Edition (*1*). The crash tests were performed in accordance with *MASH* Test Level 3 (TL-3), which requires three crash tests (as discussed in Chapter 3).

CHAPTER 2.

SYSTEM DETAILS

2.1. TEST ARTICLE AND INSTALLATION DETAILS

The test installation consisted of a Flock Safety solar panel and camera mounted on a multi-part Proveli breakaway pole, with the center of the solar panel at approximately 12 feet 10 inches above grade, and the camera 6 inches below it on the impact side. Three batteries were attached to the bottom of the solar panel. The post was connected to a base section with a break-away connection at 3 inches above grade. The base section was encased in a 12-inch diameter 30-inch-deep un-reinforced concrete foundation.

Figure 2.1 presents the overall information on the Proveli Breakaway Pole System, and Figure 2.2 thru Figure 2.7 provide photographs of the installation. Appendix A provides further details on the Proveli Breakaway Pole System. Drawings were provided by Proveli and the Texas A&M Transportation Institute (TTI) Proving Ground, and assembly and construction was performed by TTI Proving Ground personnel.

2.2. DESIGN MODIFICATIONS DURING TESTS

No modifications were made to the installation during the testing phase.

DESIGN NOTES

1. POLE AND FOUNDATIONS ARE DESIGNED IN ACCORDANCE WITH THE FOLLOWING CODES:
   - 1.1. 2021 INTERNATIONAL BUILDING CODE
   - 1.2. AASHTO LRFD SPECIFICATIONSFOR STRUCTURAL SUPPORT FOR HIGHWAY SIGNS, LUMIN, TRAFFIC SIGNALS, 2015 EDITION.
2. POLE ANALYSIS AND FOUNDATION DESIGN ARE BASED ON THE FOLLOWING CRITERIA
   - 2.1. DESIGN WIND SPEED (Vult)): (SEE SECTION 2.6)
   - 2.2. RISK CATEGORY: II
   - 2.3. EXPOSURE CATEGORY: C
   - 2.4. TOPOGRAPHIC CATEGORY: 1
   - 2.5. SEISMIC DESIGN CRITERIA:
     - 2.5.1. SOIL SITE CLASS: D (ASSUMED)
     - 2.5.2. SPECTRAL RESPONSE, Ss: 1.000g (MAXIMUM)
     - 2.5.3. SPECTRAL RESPONSE, S1: 0.400G (MAXIMUM)
     - 2.5.4. SEISMIC DESIGN CATEGORY: B
   - 2.6. STRUCTURE BASE REACTIONS ARE CALCULATED AS FOLLOWS:

DESIGN WIND SPEED (MPH)	MOMENT (K-FT)	SHEAR (KIP)	AXIAL (KIP)
115	2.70	0.280	0.160
125	3.20	0.330	0.160
135 (MAX)	3.70	0.380	0.160

   - 2.7. SHOULD ANY OF THE SITE-SPECIFIC PARAMETERS BE HIGHER THAN WHAT IS NOTED ABOVE, THE EOR SHALL BE CONTACTED TO PROVIDE A REVISED DESIGN.
3. CONTRACTOR IS RESPONSIBLE FOR VERIFYING SOIL CONDITIONS PRIOR TO INSTALLATION.
4. FOUNDATION TO CONSIST OF CONCRETE SURROUNDING THE PROPSED POLE WITH A MINMUM OF 3,000-PSI COMPRESSIVE STRENGTH.

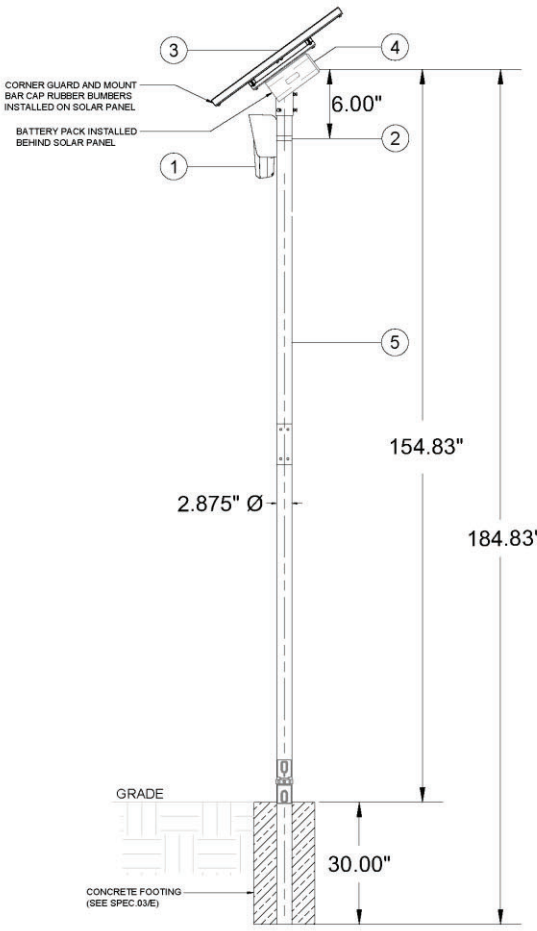
GENERAL & CONSTRUCTION NOTES

1. CONTRACTOR SHALL CONTACT DESIGNATED AGENCY TO LOCATE ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
2. CONTRACTOR SHALL APPLY AND OBTAIN AN APPROVED TRAFFIC CONTROL PLAN IN ACCORDANCE WITH MUTCD AND LOCAL JURISDICTION STANDARDS.
3. CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO ORIGINAL SITE CONDITION TO THE SATISFACTION OF STATE DEPARTMENT OF TRANSPORTATION AND LOCAL JURISDICTION.
4. ALL WORK SHALL CONFORM TO APPLICABLE ELECTRICAL CODES EXCEPT WHEN STATE DEPARTMENT OF TRANSPORTATION OR LOCAL JURISDICTION STANDARDS SUPERSEDE.
5. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPECIFICATIONS DEFINED BY THE STATE DEPARTMENT OF TRANSPORTATION OR LOCAL JURISDICTION, UNLESS SPECIFICALLY STATED OR SHOWN OTHERWISE HEREIN.

ADA COMPLIANCE NOTES

1. ALL SIDEWALK CONSTRUCTION SHALL BE IN ACCORDANCE WITH ADA TITLE II, STATE DEPARTMENT OF TRANSPORTATION, AND LOCAL JURISDICTION STANDARDS,
2. STATE DEPARTMENT OF TRANSPORTATION CURRENT EDITION STANDARDS SHALL BE USED FOR PEDESTRIAN CONTROL PLANS WHEN CLOSURE OF SIDEWALK IS REQUIRED FOR CONSTRUCTION.
3. MINIMUM CLEAR PEDESTRIAN ACCESS ROUTE (PAR) SHALL BE 48" WIDE.
4. NO OBSTRUCTION IS PERMITTED ALONG THE WIDTH OF THE SIDEWALK. UP TO AN ELEVATION OD 7'-0" ABOVE GRADE.

ITEM NO.	PART NUMBER	DESCRIPTION	TOTAL WEIGHT (LB)	QTY.
1	701-0059	FLOCK SAFETY CAMERA	3.6	1
2	201-00097	MOUNTING CLAMP	2.0	1
3	702-00080	65W SOLAR KIT	18.0	1
4	702-00026 / 701-00111	BATTERY PACK	4.0 (APPROX)	3 (MAX)
5	1020-01	PROVELI BREAKAWAY STYLE 7 COUPLER ASSEMBLY	229.39	1



1 POLE ELEVATION DETAIL

SCALE: N/A

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
0	09/05/2024	JMW	TYP DETAIL

LICENSE PLATE READER CAMERA INSTALLATION

SHEET:	REV:
SPEC.01	0

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Figure 2.1. Details of Proveli Breakaway Pole System.

Figure 2.2. Proveli Breakaway Pole System prior to Testing.

Figure 2.3. Lower Portion of the Proveli Breakaway Pole System prior to Testing.

Figure 2.4. Base of the Proveli Breakaway Pole System prior to Testing.

Figure 2.5. Joint of the Upper and Lower Portions of the Proveli Breakaway Pole System prior to Testing.

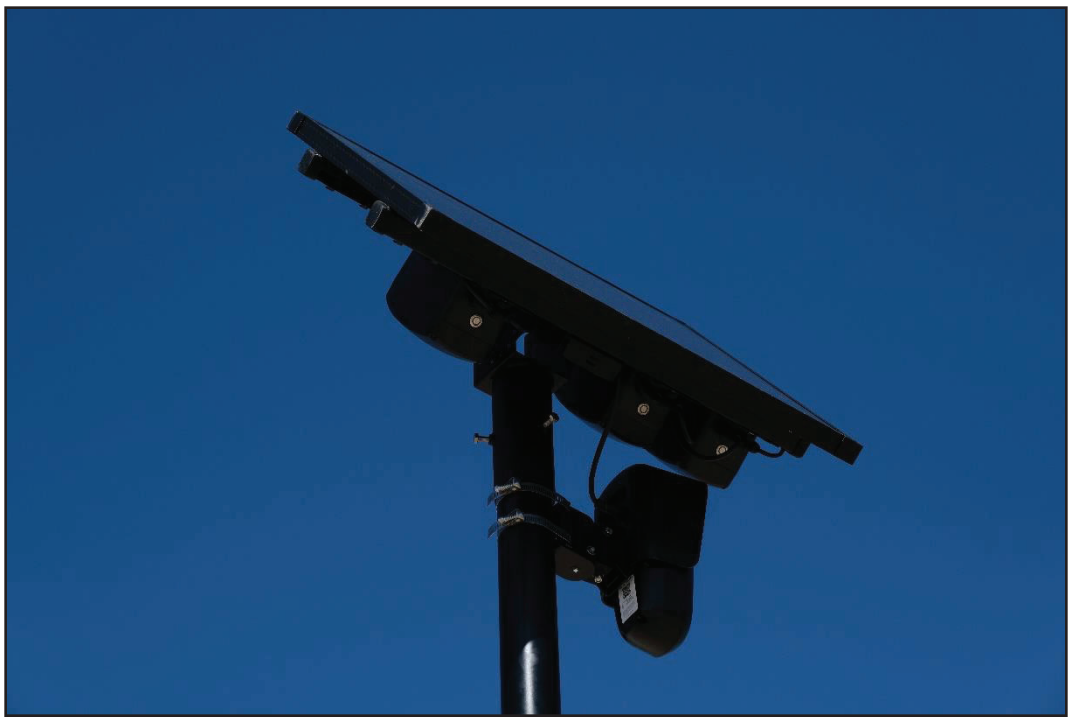


Figure 2.6. Proveli Breakaway Pole and Flock Safety Solar Panel and Camera prior to Testing.

Figure 2.7. Rear of the Proveli Breakaway Pole and Flock Safety Solar Panel prior to Testing.

2.3. MATERIAL SPECIFICATIONS

Appendix B provides material certification documents for the materials used to install/construct the Breakaway Pole System. Table 2.1 shows the average compressive strengths of the concrete on the day of the test 9/27/2024.

Table 2.1. Concrete Strength.

Location	Design Strength	Avg. Strength	Age
Footers	3000	3460	37

CHAPTER 3.

TEST REQUIREMENTS AND EVALUATION CRITERIA

3.1. CRASH TEST PERFORMED/MATRIX

Table 3.1 shows the test conditions and evaluation criteria for *MASH* TL-3 for Support Structures.

Table 3.1. Test Conditions and Evaluation Criteria Specified for *MASH* TL-3 Support Structures.

Test Designation	Test Vehicle	Impact Speed	Impact Angle	Evaluation Criteria
3-60	1100C	19 mi/h	0º	B, D, F, H, I, N
3-61	1100C	62 mi/h	0º	B, D, F, H, I, N
3-62	2270P	62 mi/h	0º	B, D, F, H, I, N

The crash tests and data analysis procedures were in accordance with guidelines presented in *MASH*. Chapter 4 presents brief descriptions of these procedures.

3.2. EVALUATION CRITERIA

The appropriate safety evaluation criteria from Tables 2-5 and 5-1 of *MASH* were used to evaluate the crash tests reported herein. Table 3.1 lists the test conditions and evaluation criteria required for *MASH* TL-3, and Table 3.2 provides detailed information on the evaluation criteria.

Table 3.2. Evaluation Criteria Required for *MASH* Testing.

Evaluation Factors	Evaluation Criteria
B.	The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding.
D.	Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone. Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.2.2 and Appendix E of *MASH*.
F.	The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.
H.	Occupant impact velocities (OIV) should satisfy the following limits: Preferred value of 10 ft/s, or maximum allowable value of 16 ft/s.
I.	The occupant ridedown accelerations should satisfy the following: Preferred value of 15.0 g, or maximum allowable value of 20.49 g.
N.	Vehicle trajectory behind the test article is acceptable.

CHAPTER 4.

TEST CONDITIONS

4.1. TEST FACILITY

The full-scale crash tests reported herein were performed at the TTI Proving Ground, an International Standards Organization (ISO)/International Electrotechnical Commission (IEC) 17025-accredited laboratory with American Association for Laboratory Accreditation (A2LA) Mechanical Testing Certificate 2821.01. The full-scale crash tests were performed according to TTI Proving Ground quality procedures, as well as *MASH* guidelines and standards.

The test facilities of the TTI Proving Ground are located on The Texas A&M University System RELLIS Campus, which consists of a 2000-acre complex of research and training facilities situated 10 mi northwest of the flagship campus of Texas A&M University. The site, formerly a United States Army Air Corps base, has large expanses of concrete runways and parking aprons well suited for experimental research and testing in the areas of vehicle performance and handling, vehicle-roadway interaction, highway pavement durability and efficacy, and roadside safety hardware and perimeter protective device evaluation. The sites selected for construction and testing are along the edge of an out-of-service apron/runway. The apron/runway consists of an unreinforced jointed-concrete pavement in 12.5-ft × 15-ft blocks nominally 6 inches deep. The aprons were built in 1942, and the joints have some displacement but are otherwise flat and level.

4.2. VEHICLE TOW AND GUIDANCE SYSTEM

For the testing utilizing the 1100C and 2270P vehicles, each was towed into the test installation using a steel cable guidance and reverse tow system. A steel cable for guiding the test vehicle was tensioned along the path, anchored at each end, and threaded through an attachment to the front wheel of the test vehicle. An additional steel cable was connected to the test vehicle, passed around a pulley near the impact point and through a pulley on the tow vehicle, and then anchored to the ground such that the tow vehicle moved away from the test site. A 2:1 speed ratio between the test and tow vehicle existed with this system. Just prior to impact with the installation, the test vehicle was released and ran unrestrained. The vehicle remained freewheeling (i.e., no steering or braking inputs) until it cleared the immediate area of the test site.

4.3. DATA ACQUISITION SYSTEMS

4.3.1. Vehicle Instrumentation and Data Processing

Each test vehicle was instrumented with a self-contained onboard data acquisition system. The signal conditioning and acquisition system is a multi-channel data acquisition system (DAS) produced by Diversified Technical Systems Inc. The accelerometers, which measure the x, y, and z axis of vehicle acceleration, are strain gauge type with linear millivolt output proportional to acceleration. Angular rate sensors, measuring vehicle roll, pitch, and yaw rates, are ultra-small, solid-state units designed for crash test service. The data acquisition hardware and software conform to the *MASH* recommended version of SAE J211, Instrumentation for Impact Test. Each of the channels is capable of providing precision amplification, scaling, and filtering based on transducer specifications and calibrations. During the test, data are recorded from each channel at a rate of 10,000 samples per second with a resolution of one part in 65,536. Once data are recorded, internal batteries back these up inside the unit in case the primary battery cable is severed. Initial contact of the pressure switch on the vehicle bumper provides a time zero mark and initiates the recording process. After each test, the data are downloaded from the DAS unit into a laptop computer at the test site. The Test Risk Assessment Program (TRAP) software then processes the raw data to produce detailed reports of the test results.

Each DAS is returned to the factory annually for complete recalibration and to ensure that all instrumentation used in the vehicle conforms to the specifications outlined by SAE J211. All accelerometers are calibrated annually by means of an ENDEVCOÒ 2901 precision primary vibration standard. This standard and its support instruments are checked annually and receive a calibration traceable to the International System of Units (SI). Measurement Uncertainties have been determined for critical parameters involved in this testing, and are available upon request by the Sponsor.

TRAP uses the DAS-captured data to compute the occupant to vehicle contact impact velocities, time of occupant to vehicle contact after vehicle impact, and highest 10-millisecond (ms) average ridedown acceleration. TRAP calculates change in vehicle velocity at the end of a given impulse period. In addition, maximum average accelerations over 50-ms intervals in each of the three directions are computed. For reporting purposes, the data from the vehicle-mounted accelerometers are filtered with an SAE Class 180-Hz low-pass digital filter, and acceleration versus time curves for the longitudinal, lateral, and vertical directions are plotted using TRAP.

TRAP uses the data from the yaw, pitch, and roll rate transducers to compute angular displacement in degrees at 0.0001-s intervals, and then plots yaw, pitch, and roll versus time. These displacements are in reference to the vehicle-fixed coordinate system with the initial position and orientation being initial impact. Measurement Uncertainties

have been determined for critical parameters involved in this testing, and are available upon request by the Sponsor.

4.3.2. Anthropomorphic Dummy Instrumentation

An Alderson Research Laboratories Hybrid II, 50th percentile male anthropomorphic dummy, restrained with lap and shoulder belts, was placed in the front seat on the right side of the 1100C vehicle. The dummy was not instrumented.

According to *MASH*, use of a dummy in the 2270P vehicle is optional, and no dummy was used in the test.

4.3.3. Photographic Instrumentation Data Processing

Photographic coverage of each test included 2 digital high-speed cameras:

- One placed with a field of view perpendicular to the impact path and in-line with the point of impact
- One placed downstream from the impact point at an oblique angle to the impact path

A flashbulb on the impacting vehicle was activated by a pressure-sensitive tape switch to indicate the instant of contact with the Breakaway Pole System. The flashbulb was visible from each camera. The video files from these digital high-speed cameras were analyzed to observe phenomena occurring during the collision and to obtain time-event, displacement, and angular data. A digital camera recorded and documented conditions of each test vehicle and the installation before and after the test.

CHAPTER 5.

MASH TEST 3-60 (CRASH TEST 690900-PVL-5)

5.1. CRITICAL IMPACT POINT LOCATION

The Critical Impact Point (CIP) for this test was centerline of the vehicle aligned 13 inches off the centerline of the installation towards the left side. The target CIP for this test was determined using the information provided in *MASH* Section 2.2.4.1. Figure 5.1 shows the target CIP for test 690900-PVL-5. Figure 5.2 and Figure 5.3 depict the vehicle at the CIP prior to test 690900-PVL-5.

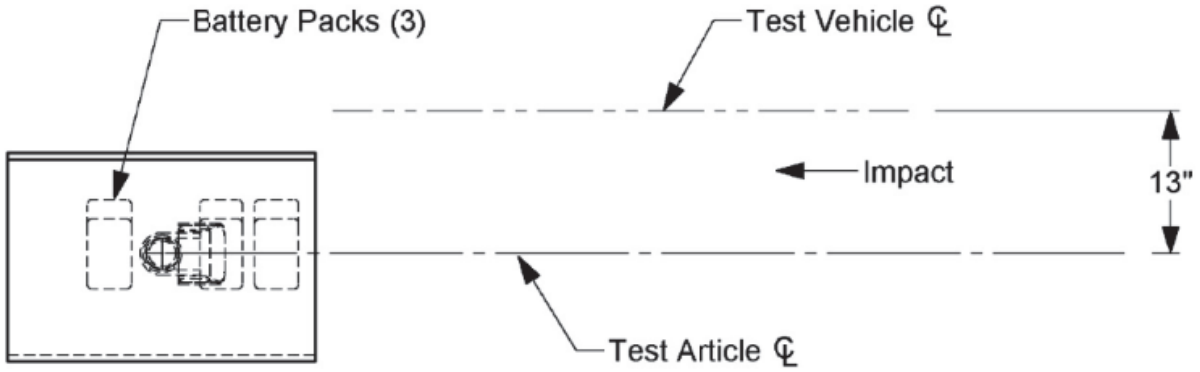


Figure 5.1. Target CIP for *MASH* Test 3-60 on Proveli Breakaway Pole System.

Figure 5.2. Proveli Breakaway Pole System/Test Vehicle Geometrics for Test 690900-PVL-5.

Figure 5.3. Proveli Breakaway Pole System/Test Vehicle Impact Location for Test 690900-PVL-5.

5.2. TEST VEHICLE DETAILS PRIOR TO IMPACT

Table 5.1 shows the vehicle measurements. Figure 5.4 and Figure 5.5 show the 2019 Nissan Versa used for the crash test. Figure C.1 in Appendix C.1 gives additional dimensions and information on the vehicle.

Table 5.1. Vehicle Measurements for Test 690900-PVL-5.

Test Parameter	Specification	Tolerance	Measured
Dummy Mass (if applicable)[a]	165 lb	N/A	165 lb
Inertial Mass	2420 lb	±55 lb	2416 lb
Gross Static[a] Mass	2585 lb	±55 lb	2581 lb
Wheelbase	98 inches	±5 inches	102.4 inches
Front Overhang	35 inches	±4 inches	32.5 inches
Overall Length	169 inches	±8 inches	175.4 inches
Overall Width	65 inches	±3 inches	66.7 inches
Hood Height	28 inches	±4 inches	30.5 inches
Track Width[b]	59 inches	±2 inches	58.4 inches
CG aft of Front Axle[c]	39 inches	±4 inches	41.1 inches
CG above Ground[c,d]	N/A	N/A	N/A

Note: N/A = not applicable; CG = center of gravity.

[a] If a dummy is used, the gross static vehicle mass should be increased by the mass of the dummy.

[b] Average of front and rear axles.

[c] For test inertial mass.

[d] 2270P vehicle must meet minimum CG height requirement.

Figure 5.4. Front of Test Vehicle before Test 690900-PVL-5.

Figure 5.5. Rear of Test Vehicle before Test 690900-PVL-5.

5.3. TEST DESCRIPTION

5.3.1. Weather Conditions

Table 5.2 provides the weather conditions for test 690900-PVL-5.

Table 5.2. Weather Conditions for Test 690900-PVL-5.

Date of Test	9/27/2024
Wind Speed	9 mi/h
Wind Direction	324°
Temperature	83°F
Relative Humidity	51 %
Vehicle Traveling	170°

5.3.2. Test Events

Table 5.3 lists events that occurred during Test 690900-PVL-5. Figures C.4, C.5, and C.6 in Appendix C.2 present sequential photographs during the test.

Table 5.3. Events during Test 690900-PVL-5.

Time	Events
0.0000 s	Vehicle impacted the installation
0.0240 s	Pole began to move
0.0340 s	Pole began to release from base
0.0560 s	Pole released from base

5.4. TEST ACTUAL IMPACT CONDITIONS

Table 5.4 lists the details of the *MASH* impact conditions for this test and Table 5.5 lists the exit parameters.

Table 5.4. Impact Conditions for *MASH Test 3-60,* Crash Test 690900-PVL-5.

Test Parameter	Specification	Tolerance	Measured
Impact Speed	19 mi/h	±2.5 mi/h	18.8 mi/h
Impact Angle	0°	±1.5°	0°
Kinetic Energy	34 kip-ft	≤34 kip-ft	28.8 kip-ft
Impact Location	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the drivers side	±6 inches	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the drivers side side

Table 5.5. Exit Parameters for *MASH Test 3-60,* Crash Test 690900-PVL-5.

Exit Parameter	Measured
Speed	14.5 mi/h
Brakes applied post impact	4.5 seconds
Vehicle at rest position	106 ft downstream of impact point In line with the impact path
Comments:	Vehicle remained upright and stable.

5.5. DAMAGE TO TEST INSTALLATION

The base of the footer was sheared off at grade and did not release from the support pole. The support pole and solar panel came to rest 40 feet downstream and 7 feet to the left of the original location of the installation. The solar panel detached from the pole but remained tethered to the camera, which remained intact. The upper section of the support pole was deformed, and there was a slight gap between the upper and lower support pole sections. Figure 5.6 and Figure 5.7 show the damage to the Proveli Breakaway Pole System.

Figure 5.6. Proveli Breakaway Pole System Base at Impact Location after Test 690900-PVL-5.

Figure 5.7. Proveli Breakaway Pole System after Test 690900-PVL-5.

5.6. DAMAGE TO TEST VEHICLE

Figure 5.8 and Figure 5.9 show the damage sustained by the vehicle. Figure 5.10 and Figure 5.11 show the interior of the test vehicle. Table 5.6 and Table 5.7 provide details on the occupant compartment deformation and exterior vehicle damage. Figures C.2 and C.3 in Appendix C.1 provide exterior crush and occupant compartment measurements.

Figure 5.8. Front of Test Vehicle after Test 690900-PVL-5.

Figure 5.9. Rear of Test Vehicle after Test 690900-PVL-5.

Figure 5.10. Overall Interior of Test Vehicle after Test 690900-PVL-5.

Figure 5.11. Windshield of Test Vehicle after Test 690900-PVL-5.

Table 5.6. Occupant Compartment Deformation for Test 690900-PVL-5.

Test Parameter	Specification	Measured
Roof	≤4.0 inches	0 inches
Windshield	≤3.0 inches	0 inches
A and B Pillars	≤5.0 overall/≤3.0 lateral inches	0 inches
Foot Well/Toe Pan	≤9.0 inches	0 inches
Floor Pan/Transmission Tunnel	≤12.0 inches	0 inches
Side Front Panel	≤12.0 inches	0 inches
Front Door (above Seat)	≤9.0 inches	0 inches
Front Door (below Seat)	≤12.0 inches	0 inches

Table 5.7. Exterior Vehicle Damage for Test 690900-PVL-5.

Test Parameter	Details
Side Windows	Side windows remained intact
Maximum Exterior Deformation	No exterior deformation
VDS	12FC1
CDC	12FCEN1
Fuel Tank Damage	None
Description of Damage to Vehicle:	There was a hairline fracture on the front bumper. Due to this minimal damage, this test vehicle was reused for test 690900-PVL-6.

5.7. OCCUPANT RISK FACTORS

Data from the accelerometers were digitized for evaluation of occupant risk, and the results are shown in Table 5.8. Figure C.7 in Appendix C.3 shows the vehicle angular displacements, and Figures C.8 through C.10 in Appendix C.4 show acceleration versus time traces.

Table 5.8. Occupant Risk Factors for Test 690900-PVL-5.

Test Parameter	Specification [a]	Measured	Time
OIV, Longitudinal	≤16.0 ft/s *10.0* ft/s	5 ft/s	0.4483 seconds on front of interior
OIV, Lateral	≤40.0 ft/s *30.0* ft/s	1.5 ft/s	0.4483 seconds on front of interior
Ridedown, Longitudinal	≤20.49 g *15.0* g	0.4 g	3.0773 - 3.0873 seconds
Ridedown, Lateral	≤20.49 g *15.0* g	0.5 g	2.8401 - 2.8501 seconds
Theoretical Head Impact Velocity (THIV)	N/A	1.6 m/s	0.4488 seconds on front of interior
Acceleration Severity Index	N/A	0.2	0.0286 - 0.0786 seconds
50-ms Moving Avg. Accelerations (MA) Longitudinal	N/A	-2.3 g	0.0096 - 0.0596 seconds
50-ms MA Lateral	N/A	-0.4 g	0.2149 - 0.2649 seconds
50-ms MA Vertical	N/A	1.2 g	0.0977 - 0.1477 seconds
Roll	≤75°	16.8°	3.9999 seconds
Pitch	≤75°	2.7°	2.8261 seconds
Yaw	N/A	1.7°	0.2824 seconds

[a.] *Values in italics are the preferred MASH values*

5.8. TEST SUMMARY

Figure 5.12 summarizes the results of *MASH* Test 690900-PVL-5.

0.000 s

0.3000 s

0.6000 s

0.9000s

GENERAL INFORMATION	
Test Agency:	Texas A&M Transportation Institute (TTI)
Test Standard/Test No.:	*MASH* 2016, Test 3-60
Project No.:	690900-PVL-5
Test Date:	9/27/2024
TEST ARTICLE	
Type:	Support Structures
Name:	Proveli Breakaway Pole System
Length:	154-8 inches
Key Materials:	28-inch × 21.3-inch solar panel, camera, 2-inch SCH 40 Galvanized Steel Pipe, 2.87500 × 0.203 wall Aluminum pipe
Soil Type and Condition:	Concrete Footer
TEST VEHICLE	
Type/Designation:	1100C
Year, Make and Model:	2019 Nissan Versa
Inertial Mass:	2416 lb
Dummy Mass:	165 lb
Gross Static Mass:	2581 lb
IMPACT CONDITIONS	
Impact Speed:	18.8 mi/h
Impact Angle:	0°
Impact Location:	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the drivers side
Kinetic Energy:	28.8 kip-ft

EXIT CONDITIONS	
Exit Speed:	14.5 mi/h
Stopping Distance:	106 ft downstream In line
VEHICLE DAMAGE	
VDS:	12FC1
CDC:	12FCEN1
Max Exterior Deformation:	No exterior deformation
Max Occupant Compartment Deformation:	No occupant compartment deformation
OCCUPANT RISK VALUES	
Longitudinal OIV:	5 ft/s
Lateral OIV:	1.5 ft/s
Longitudinal Ridedown:	0.4 g
Lateral Ridedown:	0.5 g
THIV:	1.6 m/s
ASI:	0.2
Max 50ms Longitudinal:	-2.3 g
Max 50ms Lateral:	-0.4 g
Max 50ms Vertical:	1.2 g
Max Roll:	16.8°
Max Pitch:	2.7°
Max Yaw:	1.7°

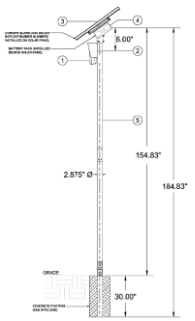


Figure 5.12. Summary of Results for MASH Test 3-60 on Provli Breakaway Pole System.

CHAPTER 6.

MASH TEST 3-61 (CRASH TEST 690900-PVL-6)

6.1. CRITICAL IMPACT POINT LOCATION

The Critical Impact Point (CIP) for this test was centerline of the vehicle aligned 13 inches off the centerline of the installation towards the left side. The target CIP for this test was determined using the information provided in *MASH* Section 2.2.4.1. Figure 6.1 shows the target CIP for test 690900-PVL-6. Figure 6.2 and Figure 6.3 depict the vehicle at the CIP prior to test 690900-PVL-6.

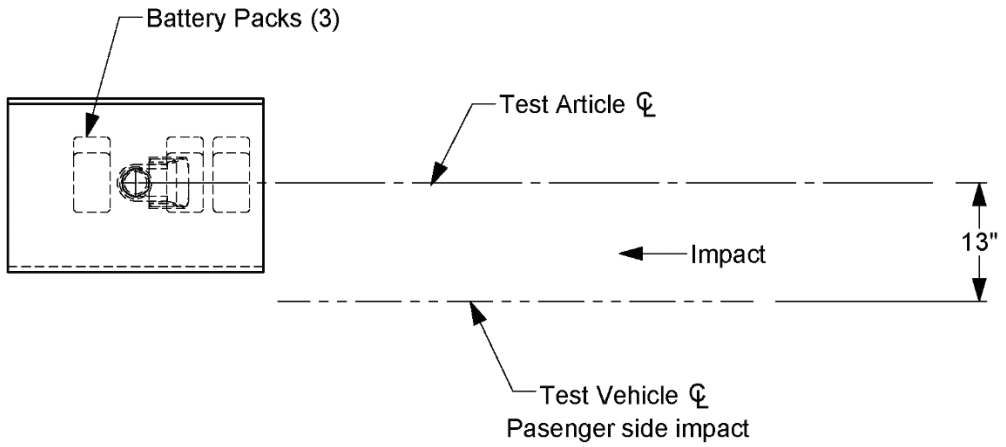


Figure 6.1. Target CIP for *MASH* Test 3-61 on Proveli Breakaway Pole System.

Figure 6.2. Proveli Breakaway Pole System/Test Vehicle Geometrics for Test 690900-PVL-6.

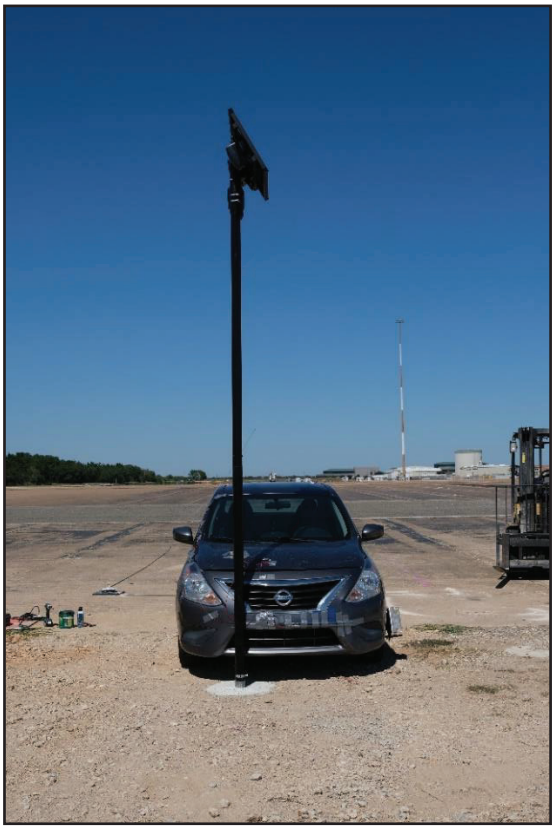


Figure 6.3. Proveli Breakaway Pole System/Test Vehicle Impact Location for Test 690900-PVL-6.

6.2. TEST VEHICLE DETAILS PRIOR TO IMPACT

Table 6.1 shows the vehicle measurements. Figure 6.4 and Figure 6.5 show the 2019 Nissan Versa used for the crash test. Due to the minimal damage caused by test 690900-PVL-5, the same vehicle was used for this test. Figure D.1 in Appendix D.1 gives additional dimensions and information on the vehicle.

Table 6.1. Vehicle Measurements for Test 690900-PVL-6.

Test Parameter	Specification	Tolerance	Measured
Dummy Mass (if applicable)[a]	165 lb	N/A	165 lb
Inertial Mass	2420 lb	±55 lb	2416 lb
Gross Static[a] Mass	2585 lb	±55 lb	2581 lb
Wheelbase	98 inches	±5 inches	102.4 inches
Front Overhang	35 inches	±4 inches	32.5 inches
Overall Length	169 inches	±8 inches	175.4 inches
Overall Width	65 inches	±3 inches	66.7 inches
Hood Height	28 inches	±4 inches	30.5 inches
Track Width[b]	59 inches	±2 inches	58.4 inches
CG aft of Front Axle[c]	39 inches	±4 inches	41.1 inches
CG above Ground[c,d]	N/A	N/A	N/A

Note: N/A = not applicable; CG = center of gravity.

[a] If a dummy is used, the gross static vehicle mass should be increased by the mass of the dummy.

[b] Average of front and rear axles.

[c] For test inertial mass.

[d] 2270P vehicle must meet minimum CG height requirement.

Figure 6.4. Front of Test Vehicle before Test 690900-PVL-6.

Figure 6.5. Rear of Test Vehicle before Test 690900-PVL-6.

6.3. TEST DESCRIPTION

6.3.1. Weather Conditions

Table 6.2 provides the weather conditions for test 690900-PVL-6.

Table 6.2. Weather Conditions for Test 690900-PVL-6.

Date of Test	9/27/2024
Wind Speed	8 mi/h
Wind Direction	334°
Temperature	89 °F
Relative Humidity	42 %
Vehicle Traveling	170°

6.3.2. Test Events

Table 6.3 lists events that occurred during Test 690900-PVL-6. Figures D.4, D.5, and D.6 in Appendix D.2 present sequential photographs during the test.

Table 6.3. Events during Test 690900-PVL-6.

Time	Events
0.0000 s	Vehicle impacted the installation
0.0010 s	Pole began to move
0.0018 s	Pole began to release from base
0.0021 s	Pole released from base
0.2310 s	Top bracing on pole support impacted rear spoiler

6.4. TEST ACTUAL IMPACT CONDITIONS

Table 6.4 lists the details of the *MASH* impact conditions for this test and Table 6.5 lists the exit parameters.

Table 6.4. Impact Conditions for *MASH Test 3-61,* Crash Test 690900-PVL-6.

Test Parameter	Specification	Tolerance	Measured
Impact Speed	62 mi/h	±2.5 mi/h	62.3 mi/h
Impact Angle	0°	±1.5°	0°
Kinetic Energy	288 kip-ft	≥288 kip-ft	316.7 kip-ft
Impact Location	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the passenger side	±6 inches	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the passenger side

Table 6.5. Exit Parameters for *MASH Test 3-61,* Crash Test 690900-PVL-6.

Exit Parameter	Measured
Speed	60.3 mi/h
Brakes applied post impact	2.0 seconds
Vehicle at rest position	345 ft downstream of impact point 12 ft to the right
Comments:	Vehicle remained upright and stable.

6.5. DAMAGE TO TEST INSTALLATION

The base of the footer was deformed, and the lower portion of the support pole sheared. The support pole came to rest 60 feet downstream and 6 feet to the left of the original location of the installation. The lower portion of the support pole was deformed one foot from its base. The solar panel and camera both released from the support pole. Figure 6.6 and Figure 6.7 show the damage to the Proveli Breakaway Pole System.

Figure 6.6. Proveli Breakaway Pole System Base at Impact Location after Test 690900-PVL-6.

Figure 6.7. Proveli Breakaway Pole System after Test 690900-PVL-6.

6.6. DAMAGE TO TEST VEHICLE

Figure 6.8 and Figure 6.9 show the damage sustained by the vehicle. Figure 6.10 and Figure 6.11 show the interior of the test vehicle. Table 6.6 and Table 6.7 provide details on the occupant compartment deformation and exterior vehicle damage. Figures D.2 and D.3 in Appendix D.1 provide exterior crush and occupant compartment measurements.

Figure 6.8. Impact Side of Test Vehicle after Test 690900-PVL-6.

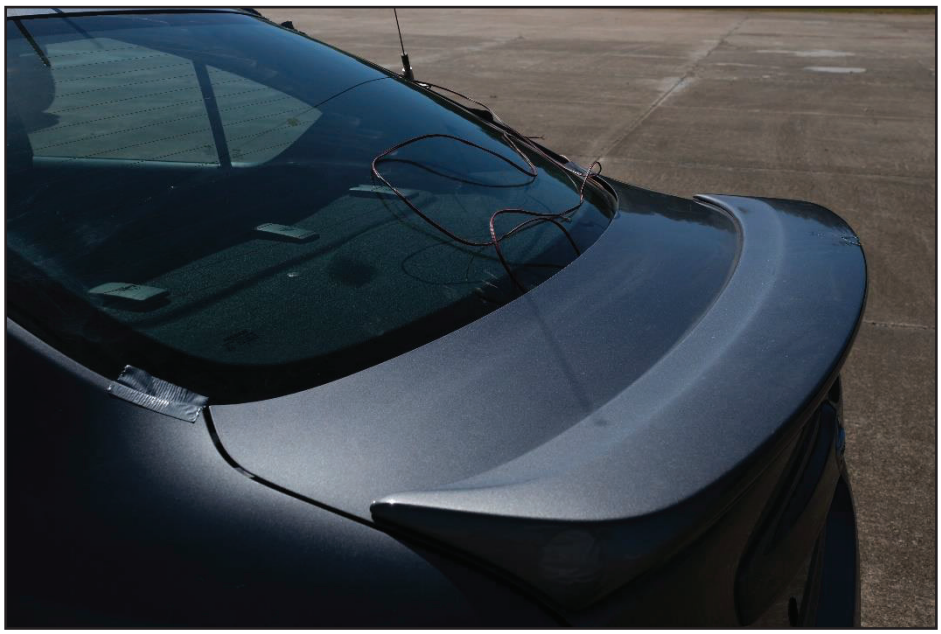


Figure 6.9. Rear of Test Vehicle after Test 690900-PVL-6.

Figure 6.10. Overall Interior of Test Vehicle after Test 690900-PVL-6.

Figure 6.11. Windshield after Test 690900-PVL-6.

Table 6.6. Occupant Compartment Deformation for Test 690900-PVL-6.

Test Parameter	Specification	Measured
Roof	≤4.0 inches	0 inches
Windshield	≤3.0 inches	0 inches
A and B Pillars	≤5.0 overall/≤3.0 lateral inches	0 inches
Foot Well/Toe Pan	≤9.0 inches	0 inches
Floor Pan/Transmission Tunnel	≤12.0 inches	0 inches
Side Front Panel	≤12.0 inches	0 inches
Front Door (above Seat)	≤9.0 inches	0 inches
Front Door (below Seat)	≤12.0 inches	0 inches

Table 6.7. Exterior Vehicle Damage for Test 690900-PVL-6.

Test Parameter	Details
Side Windows	Side windows remained intact
Maximum Exterior Deformation	10 inches in the front plane at bumper height
VDS	12FC2
CDC	12FCEN1
Fuel Tank Damage	None
Description of Damage to Vehicle:	The front bumper, grill, hood, radiator, and support were deformed, and the rear spoiler was fractured on the right side

6.7. OCCUPANT RISK FACTORS

Data from the accelerometers were digitized for evaluation of occupant risk, and the results are shown in Table 6.8. Figure D.7 in Appendix D.3 shows the vehicle angular displacements, and Figures D.8 through D.10 in Appendix D.4 show acceleration versus time traces.

Table 6.8. Occupant Risk Factors for Test 690900-PVL-6.

Test Parameter	Specification [a]	Measured	Time
OIV, Longitudinal	≤16.0 ft/s *10.0* ft/s	4.8 ft/s	0.4965 seconds on front of interior
OIV, Lateral	≤40.0 ft/s *30.0* ft/s	3.2 ft/s	0.4965 seconds on front of interior
Ridedown, Longitudinal	≤20.49 g *15.0* g	0.5 g	0.7243 - 0.7343 seconds
Ridedown, Lateral	≤20.49 g *15.0* g	0.7 g	1.2059 - 1.2159 seconds
Theoretical Head Impact Velocity (THIV)	N/A	1.8 m/s	0.5027 seconds on front of interior
Acceleration Severity Index	N/A	0.2	0.0252 - 0.0752 seconds
50-ms Moving Avg. Accelerations (MA) Longitudinal	N/A	-2.5 g	0.0005 - 0.0505 seconds
50-ms MA Lateral	N/A	1.5 g	0.0204 - 0.0704 seconds
50-ms MA Vertical	N/A	2.7 g	0.0417 - 0.0917 seconds
Roll	≤75°	3.2°	1.2721 seconds
Pitch	≤75°	2.7°	1.6861 seconds
Yaw	N/A	4.6°	0.5426 seconds

[a.] *Values in italics are the preferred MASH values*

6.8. TEST SUMMARY

Figure 6.12 summarizes the results of *MASH* Test 690900-PVL-6.

0.000 s

0.1000 s

0.2000 s

0.3000s

GENERAL INFORMATION	
Test Agency:	Texas A&M Transportation Institute (TTI)
Test Standard/Test No.:	*MASH* 2016, Test 3-61
Project No.:	690900-PVL-6
Test Date:	9/27/2024
TEST ARTICLE	
Type:	Support Structures
Name:	Proveli Breakaway Pole System
Length:	154-8 inches
Key Materials:	28-inch × 21.3-inch solar panel, camera, 2-inch SCH 40 Galvanized Steel Pipe, 2.87500 × 0.203 wall Aluminum pipe
Soil Type and Condition:	Concrete Footer
TEST VEHICLE	
Type/Designation:	1100C
Year, Make and Model:	2019 Nissan Versa
Inertial Mass:	2416 lb
Dummy Mass:	165 lb
Gross Static Mass:	2581 lb
IMPACT CONDITIONS	
Impact Speed:	62.3 mi/h
Impact Angle:	0°
Impact Location:	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the passenger side
Kinetic Energy:	316.7 kip-ft

EXIT CONDITIONS	
Exit Speed:	60.3 mi/h
Stopping Distance:	345 ft downstream 12 ft to the right side
VEHICLE DAMAGE	
VDS:	12FC2
CDC:	12FCEN1
Max Exterior Deformation:	10 inches in the front plane at bumper height
Max Occupant Compartment Deformation:	No occupant compartment deformation
OCCUPANT RISK VALUES	
Longitudinal OIV:	4.8 ft/s
Lateral OIV:	3.2 ft/s
Longitudinal Ridedown:	0.5 g
Lateral Ridedown:	0.7 g
THIV:	1.8 m/s
ASI:	0.2
Max 50ms Longitudinal:	-2.5 g
Max 50ms Lateral:	1.5 g
Max 50ms Vertical:	2.7 g
Max Roll:	3.2°
Max Pitch:	2.7°
Max Yaw:	4.6°

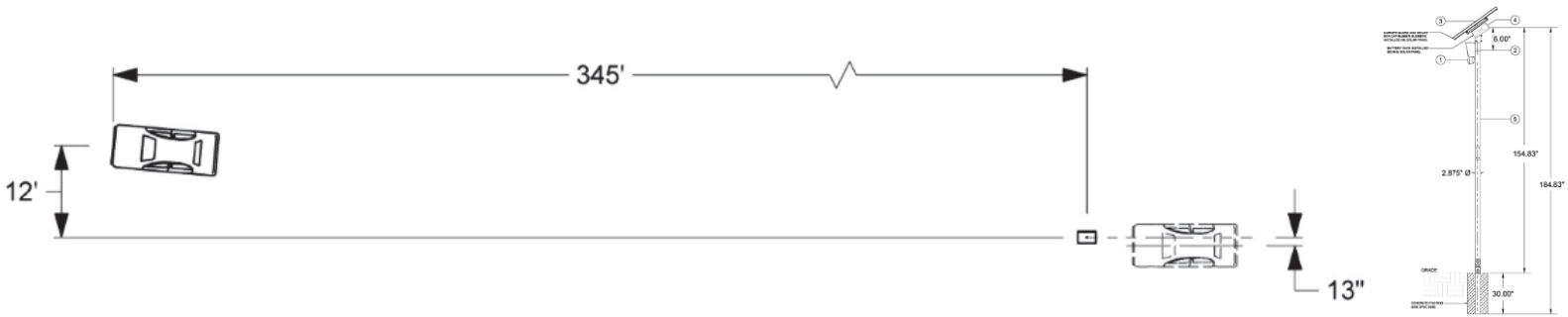


Figure 6.12. Summary of Results for MASH Test 3-61 on Proveli Breakaway Pole System.

CHAPTER 7.

MASH TEST 3-62 (CRASH TEST 690900-PVL-7)

7.1. CRITICAL IMPACT POINT LOCATION

The Critical Impact Point (CIP) for this test was centerline of the vehicle aligned 13 inches off the centerline of the installation towards the left side. The target CIP for this test was determined using the information provided in *MASH* Section 2.2.4.1. Figure 7.1 shows the target CIP for test 690900-PVL-7. Figure 7.2 and Figure 7.3 depict the vehicle at the CIP prior to test 690900-PVL-7.

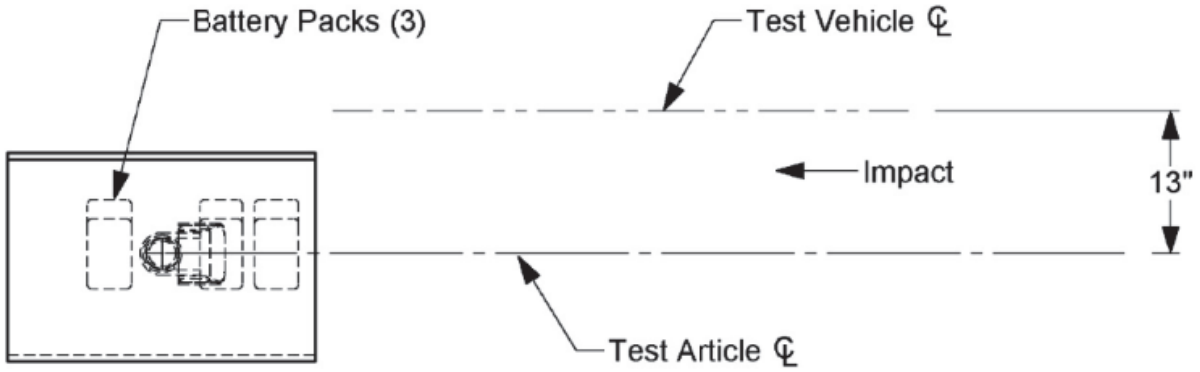


Figure 7.1. Target CIP for *MASH* Test 3-62 on Proveli Breakaway Pole System.

Figure 7.2. Proveli Breakaway Pole System/Test Vehicle Geometrics for Test 690900-PVL-7.

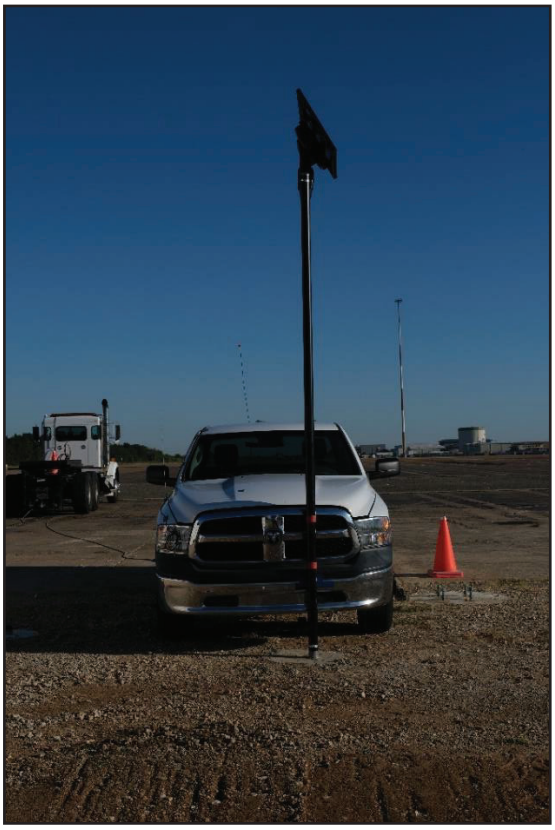


Figure 7.3. Proveli Breakaway Pole System/Test Vehicle Impact Location for Test 690900-PVL-7.

7.2. TEST VEHICLE DETAILS PRIOR TO IMPACT

Table 7.1 shows the vehicle measurements. Figure 7.4 and Figure 7.5 show the 2018 RAM 1500 used for the crash test. Figure E.1 in Appendix E.1 gives additional dimensions and information on the vehicle.

Table 7.1. Vehicle Measurements for Test 690900-PVL-7.

Test Parameter	Specification	Tolerance	Measured
Dummy Mass (if applicable)[a]	165 lb	N/A	N/A
Inertial Mass	5000 lb	±110 lb	5031 lb
Gross Static[a] Mass	5000 lb	±110 lb	5031 lb
Wheelbase	148 inches	±12 inches	140.5 inches
Front Overhang	39 inches	±3 inches	40.3 inches
Overall Length	237 inches	±13 inches	229 inches
Overall Width	78 inches	±2 inches	78.5 inches
Hood Height	43 inches	±4 inches	46 inches
Track Width[b]	67 inches	±1.5 inches	68.3 inches
CG aft of Front Axle[c]	63 inches	±4 inches	62.1 inches
CG above Ground[c,d]	28 inches	28 inches	28.8 inches

Note: N/A = not applicable; CG = center of gravity.

[a] If a dummy is used, the gross static vehicle mass should be increased by the mass of the dummy.

[b] Average of front and rear axles.

[c] For test inertial mass.

[d] 2270P vehicle must meet minimum CG height requirement.

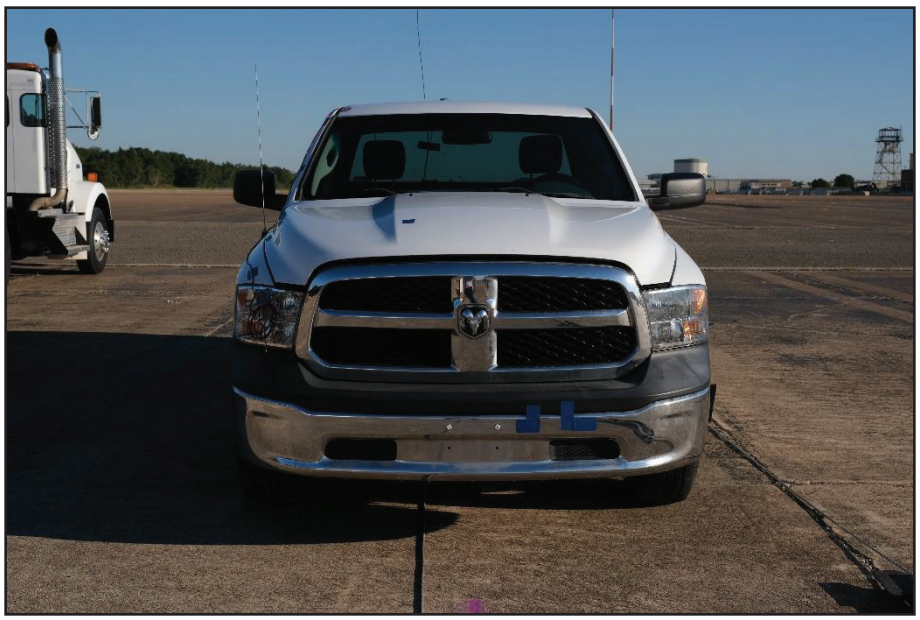


Figure 7.4. Front of Test Vehicle before Test 690900-PVL-7.

Figure 7.5. Rear of Test Vehicle before Test 690900-PVL-7.

7.3. TEST DESCRIPTION

7.3.1. Weather Conditions

Table 7.2 provides the weather conditions for test 690900-PVL-7.

Table 7.2. Weather Conditions for Test 690900-PVL-7.

Date of Test	9/27/2024
Wind Speed	8 mi/h
Wind Direction	300°
Temperature	76 °F
Relative Humidity	66 %
Vehicle Traveling	170°

7.3.2. Test Events

Table 7.3 lists events that occurred during Test 690900-PVL-7. Figures E.4, E.5, and E.6 in Appendix E.2 present sequential photographs during the test.

Table 7.3. Events during Test 690900-PVL-7.

Time	Events
0.0000 s	Vehicle impacted the installation
0.0040 s	Pole began to move
0.0090 s	Pole began to release from base
0.0150 s	Pole released from base
0.0200 s	Solar panel and camera released from support pole
0.1340 s	Post impacted the roof at windshield

7.4. TEST ACTUAL IMPACT CONDITIONS

Table 7.4 lists the details of the *MASH* impact conditions for this test and Table 7.5 lists the exit parameters.

Table 7.4. Impact Conditions for *MASH TEST 3-62,* Crash Test 690900-PVL-7.

Test Parameter	Specification	Tolerance	Measured
Impact Speed	62 mi/h	±2.5 mi/h	62.7 mi/h
Impact Angle	0°	±1.5°	0°
Kinetic Energy	594 kip-ft	≥594 kip-ft	661.2 kip-ft
Impact Location	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the left side	±6 inches	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the left side

Table 7.5. Exit Parameters for *MASH TEST 3-62,* Crash Test 690900-PVL-7.

Exit Parameter	Measured
Speed	61.7 mi/h
Brakes applied post impact	2.5 seconds
Vehicle at rest position	431 ft downstream of impact point In line with the impact path
Comments:	Vehicle remained upright and stable.

7.5. DAMAGE TO TEST INSTALLATION

The base of the footer was deformed, and the lower portion of the support pole sheared. The support pole came to rest 360 feet downstream and 50 feet to the left of the original location of the installation. The lower and upper portions of the support pole were deformed. The solar panel and camera released from the support pole and came to rest at the original location of the installation. Figure 7.6 and Figure 7.7 show the damage to the Proveli Breakaway Pole System.

Figure 7.6. Proveli Breakaway Pole System Base at Impact Location after Test 690900-PVL-7.

Figure 7.7. Proveli Breakaway Pole System after Test 690900-PVL-7.

7.6. DAMAGE TO TEST VEHICLE

Figure 7.8 and Figure 7.9 show the damage sustained by the vehicle. Figure 7.10 and Figure 7.11 show the interior of the test vehicle. Table 7.6 and Table 7.7 provide details on the occupant compartment deformation and exterior vehicle damage. Figures E.2 and E.3 in Appendix E.1 provide exterior crush and occupant compartment measurements.

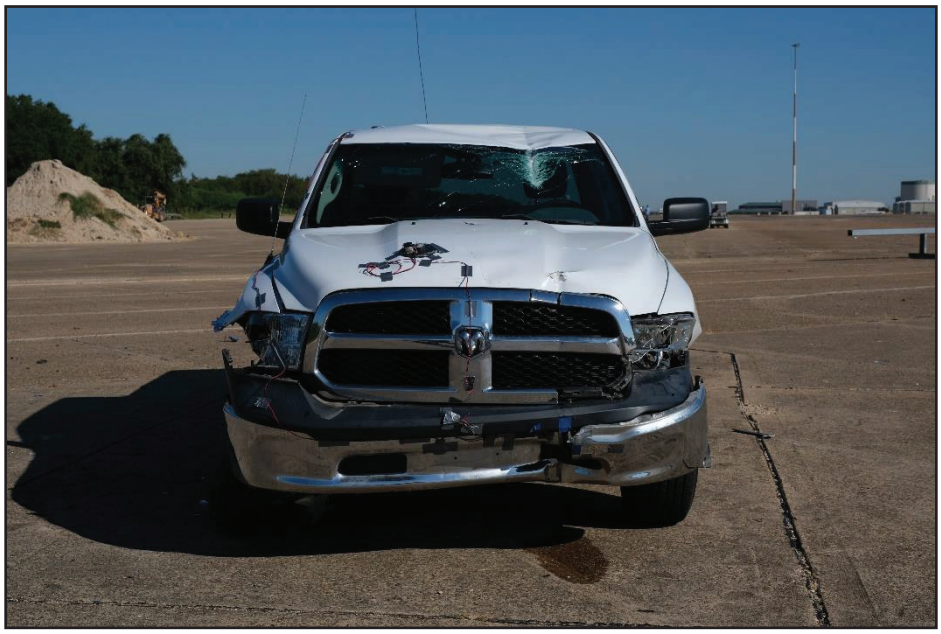


Figure 7.8. Front of Test Vehicle after Test 690900-PVL-7.

Figure 7.9. Test Vehicle Roof after Test 690900-PVL-7.

Figure 7.10. Overall Interior of Test Vehicle after Test 690900-PVL-7.

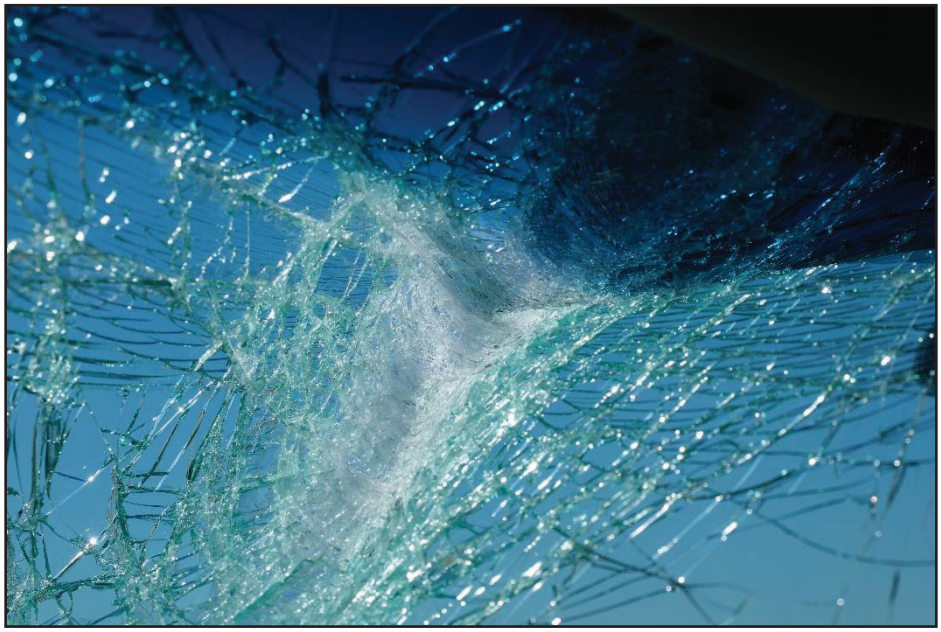


Figure 7.11. Windshield Damage after Test 690900-PVL-7.

Table 7.6. Occupant Compartment Deformation for Test 690900-PVL-7.

Test Parameter	Specification	Measured
Roof	≤4.0 inches	2.8 inches
Windshield	≤3.0 inches	1.8 inches
A and B Pillars	≤5.0 overall/≤3.0 lateral inches	0.0 inches
Foot Well/Toe Pan	≤9.0 inches	0.0 inches
Floor Pan/Transmission Tunnel	≤12.0 inches	0.0 inches
Side Front Panel	≤12.0 inches	0.0 inches
Front Door (above Seat)	≤9.0 inches	0.0 inches
Front Door (below Seat)	≤12.0 inches	0.0 inches

Table 7.7. Exterior Vehicle Damage for Test 690900-PVL-7.

Test Parameter	Details
Side Windows	Side windows remained intact
Maximum Exterior Deformation	8 inches in the front plane at bumper height
VDS	12FC2
CDC	12FCEN1
Fuel Tank Damage	None
Description of Damage to Vehicle:	There was a 4-inch-wide × 1.5-inch-deep deformation in the hood on the left side, a 2.5-inch long × 0.5-inch-wide puncture in the center of the hood 11 inches in front of the windshield. The windshield had a 16-inch-long × 16-inch wide and maximum 1.8-inch-deep fracture and deformation. There were no punctures or tears in the laminate. The roof had a 29-inch-long × 26-inch wide × 2.8-inch-deep deformation on the front left side. The bumper and grill were also damaged.

7.7. OCCUPANT RISK FACTORS

Data from the accelerometers were digitized for evaluation of occupant risk, and the results are shown in Table 7.8. Figure E.7 in Appendix E.3 shows the vehicle angular displacements, and Figures E.8 through E.10 in Appendix E.4 show acceleration versus time traces.

Table 7.8. Occupant Risk Factors for Test 690900-PVL-7.

Test Parameter	Specification [a]	Measured	Time
OIV, Longitudinal	≤16.0 ft/s *10.0* ft/s	3.5 ft/s	0.7798 seconds on front of interior
OIV, Lateral	≤40.0 ft/s *30.0* ft/s	1.9 ft/s	0.7798 seconds on front of interior
Ridedown, Longitudinal	≤20.49 g *15.0* g	0.2 g	1.3558 - 1.3658 seconds
Ridedown, Lateral	≤20.49 g *15.0* g	0.4 g	0.8536 - 0.8636 seconds
Theoretical Head Impact Velocity (THIV)	N/A	1.2 m/s	0.7796 seconds on front of interior
Acceleration Severity Index	N/A	0.1	0.0125 - 0.0625 seconds
50-ms Moving Avg. Accelerations (MA) Longitudinal	N/A	-1 g	0.0000 - 0.0500 seconds
50-ms MA Lateral	N/A	0.4 g	0.0988 - 0.1488 seconds
50-ms MA Vertical	N/A	-1 g	0.1526 - 0.2026 seconds
Roll	≤75°	1°	1.6875 seconds
Pitch	≤75°	1.9°	1.7904 seconds
Yaw	N/A	1.6°	1.9445 seconds

[a.] *Values in italics are the preferred MASH values*

7.8. TEST SUMMARY

Figure 7.12 summarizes the results of *MASH* Test 690900-PVL-7.

0.000 s

0.1000 s

0.2000 s

0.3000s

GENERAL INFORMATION	
Test Agency:	Texas A&M Transportation Institute (TTI)
Test Standard/Test No.:	*MASH* 2016, Test 3-62
Project No.:	690900-PVL-7
Test Date:	9/27/2024
TEST ARTICLE	
Type:	Support Structures
Name:	Proveli Breakaway Pole System
Length:	154-8 inches
Key Materials:	28-inch × 21.3-inch solar panel, camera, 2-inch SCH 40 Galvanized Steel Pipe, 2.87500 × 0.203 wall Aluminum pipe
Soil Type and Condition:	Concrete Footer
TEST VEHICLE	
Type/Designation:	2270P
Year, Make and Model:	2018 RAM 1500
Inertial Mass:	5031 lb
Dummy Mass:	N/A
Gross Static Mass:	5031 lb
IMPACT CONDITIONS	
Impact Speed:	62.7 mi/h
Impact Angle:	0°
Impact Location:	Centerline of the vehicle aligned 13 inches off the centerline of the installation towards the drivers side
Kinetic Energy:	661.2 kip-ft

EXIT CONDITIONS	
Exit Speed:	61.7 mi/h
Stopping Distance:	431 ft downstream In line
VEHICLE DAMAGE	
VDS:	12FC2
CDC:	12FCEN1
Max Exterior Deformation:	8 inches in the front plane at bumper height
Max Occupant Compartment Deformation:	2.8 inches in the roof
OCCUPANT RISK VALUES	
Longitudinal OIV:	3.5 ft/s
Lateral OIV:	1.9 ft/s
Longitudinal Ridedown:	0.2 g
Lateral Ridedown:	0.4 g
THIV:	1.2 m/s
ASI:	0.1
Max 50ms Longitudinal:	-1 g
Max 50ms Lateral:	0.4 g
Max 50ms Vertical:	-1 g
Max Roll:	1°
Max Pitch:	1.9°
Max Yaw:	1.6°

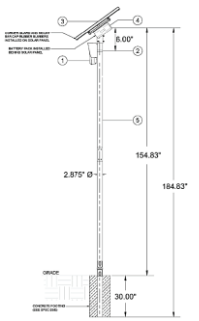


Figure 7.12. Summary of Results for MASH Test 3-62 on Proveli Breakaway Pole System.

CHAPTER 8.

SUMMARY AND CONCLUSIONS

The crash tests reported herein were performed in accordance with *MASH* TL-3, which involves three tests, on the Proveli Breakaway Pole System.

Table 8.1 shows that the Proveli Breakaway Pole System met the performance criteria for *MASH* TL-3 Support Structures.

Table 8.1. Assessment Summary for *MASH* TL-3 Tests on Proveli Breakaway Pole System.

Evaluation Criteria	**Description**	**Test 690900-PVL-5** *(MASH* Test 3-60)	**Test 690900-PVL-6** *(MASH* Test 3-61)	**Test 690900-PVL-7** *(MASH* Test 3-62)
B	Test Article Broke Away, Fractured, Yielded	S	S	S
D	No Penetration into Occupant Compartment	S	S	S
F	Roll and Pitch Limit	S	S	S
H	OIV Threshold	S	S	S
I	Ridedown Threshold	S	S	S
N	Vehicle Trajectory Behind Test Article Acceptable	S	S	S
Overall	Evaluation	Pass	Pass	Pass

Note: S = Satisfactory;
[1] See Table 3.2 for details

REFERENCES

1. AASHTO. *Manual for Assessing Safety Hardware*, Second Edition. American Association of State Highway and Transportation Officials, Washington, DC, 2016.

APPENDIX A.

DETAILS OF PROVELI BREAKAWAY POLE SYSTEM

DESIGN NOTES

1. POLE AND FOUNDATIONS ARE DESIGNED IN ACCORDANCE WITH THE FOLLOWING CODES:
   - 1.1. 2021 INTERNATIONAL BUILDING CODE
   - 1.2. AASHTO LRFD SPECIFICATIONSFOR STRUCTURAL SUPPORT FOR HIGHWAY SIGNS, LUMIN, TRAFFIC SIGNALS, 2015 EDITION.
2. POLE ANALYSIS AND FOUNDATION DESIGN ARE BASED ON THE FOLLOWING CRITERIA
   - 2.1. DESIGN WIND SPEED (Vult)): (SEE SECTION 2.6)
   - 2.2. RISK CATEGORY: II
   - 2.3. EXPOSURE CATEGORY: C
   - 2.4. TOPOGRAPHIC CATEGORY: 1
   - 2.5. SEISMIC DESIGN CRITERIA:
     - 2.5.1. SOIL SITE CLASS: D (ASSUMED)
     - 2.5.2. SPECTRAL RESPONSE, Ss: 1.000g (MAXIMUM)
     - 2.5.3. SPECTRAL RESPONSE, S1: 0.400G (MAXIMUM)
     - 2.5.4. SEISMIC DESIGN CATEGORY: B
   - 2.6. STRUCTURE BASE REACTIONS ARE CALCULATED AS FOLLOWS:

DESIGN WIND SPEED (MPH)	MOMENT (K-FT)	SHEAR (KIP)	AXIAL (KIP)
115	2.70	0.280	0.160
125	3.20	0.330	0.160
135 (MAX)	3.70	0.380	0.160

   - 2.7. SHOULD ANY OF THE SITE-SPECIFIC PARAMETERS BE HIGHER THAN WHAT IS NOTED ABOVE, THE EOR SHALL BE CONTACTED TO PROVIDE A REVISED DESIGN.
3. CONTRACTOR IS RESPONSIBLE FOR VERIFYING SOIL CONDITIONS PRIOR TO INSTALLATION.
4. FOUNDATION TO CONSIST OF CONCRETE SURROUNDING THE PROPSED POLE WITH A MINMUM OF 3,000-PSI COMPRESSIVE STRENGTH.

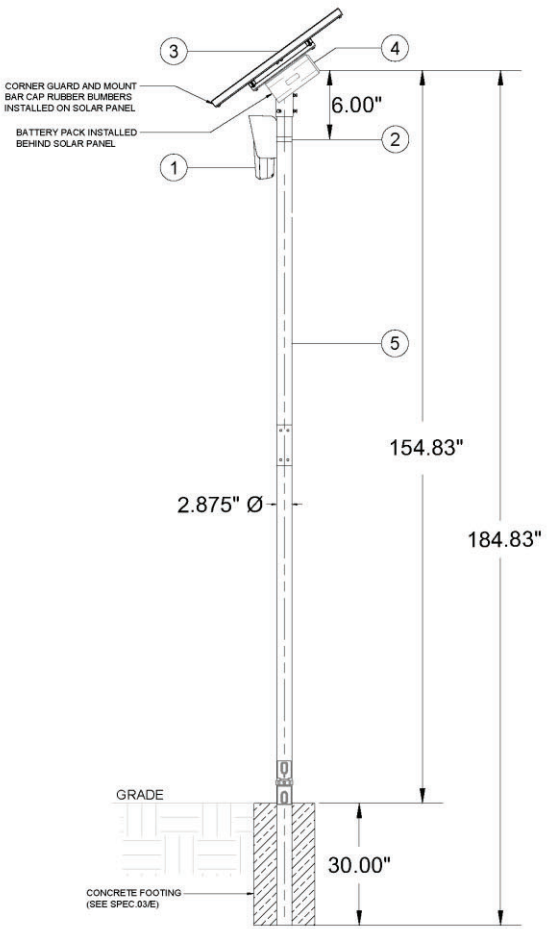
GENERAL & CONSTRUCTION NOTES

1. CONTRACTOR SHALL CONTACT DESIGNATED AGENCY TO LOCATE ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
2. CONTRACTOR SHALL APPLY AND OBTAIN AN APPROVED TRAFFIC CONTROL PLAN IN ACCORDANCE WITH MUTCD AND LOCAL JURISDICTION STANDARDS.
3. CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO ORIGINAL SITE CONDITION TO THE SATISFACTION OF STATE DEPARTMENT OF TRANSPORTATION AND LOCAL JURISDICTION.
4. ALL WORK SHALL CONFORM TO APPLICABLE ELECTRICAL CODES EXCEPT WHEN STATE DEPARTMENT OF TRANSPORTATION OR LOCAL JURISDICTION STANDARDS SUPERSEDE.
5. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPECIFICATIONS DEFINED BY THE STATE DEPARTMENT OF TRANSPORTATION OR LOCAL JURISDICTION, UNLESS SPECIFICALLY STATED OR SHOWN OTHERWISE HEREIN.

ADA COMPLIANCE NOTES

1. ALL SIDEWALK CONSTRUCTION SHALL BE IN ACCORDANCE WITH ADA TITLE II, STATE DEPARTMENT OF TRANSPORTATION, AND LOCAL JURISDICTION STANDARDS,
2. STATE DEPARTMENT OF TRANSPORTATION CURRENT EDITION STANDARDS SHALL BE USED FOR PEDESTRIAN CONTROL PLANS WHEN CLOSURE OF SIDEWALK IS REQUIRED FOR CONSTRUCTION.
3. MINIMUM CLEAR PEDESTRIAN ACCESS ROUTE (PAR) SHALL BE 48" WIDE.
4. NO OBSTRUCTION IS PERMITTED ALONG THE WIDTH OF THE SIDEWALK. UP TO AN ELEVATION OD 7'-0" ABOVE GRADE.

ITEM NO.	PART NUMBER	DESCRIPTION	TOTAL WEIGHT (LB)	QTY.
1	701-0059	FLOCK SAFETY CAMERA	3.6	1
2	201-00097	MOUNTING CLAMP	2.0	1
3	702-00080	65W SOLAR KIT	18.0	1
4	702-00028 / 701-00111	BATTERY PACK	4.0 (APPROX)	3 (MAX)
5	1020-01	PROVELI BREAKAWAY STYLE 7 COUPLER ASSEMBLY	229.39	1



1 POLE ELEVATION DETAIL

SCALE: N/A

flock safety

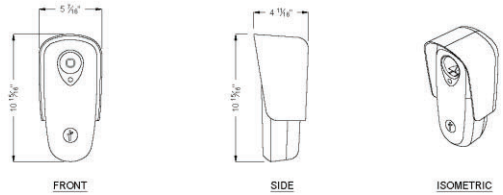
1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
0	09/05/2024	JMW	TYP DETAIL

LICENSE PLATE READER CAMERA INSTALLATION

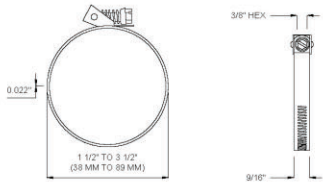
SHEET:	REV:
SPEC.01	0

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FLOCK SAFETY. ANY REPRODUCTION IN PART OR IN WHOLE WITHOUT THE WRITTEN PERMISSION OF FLOCK SAFETY IS PROHIBITED. DO NOT SCALE DRAWINGS.



SUPPLIED BY FLOCK SAFETY
MODEL 701-00059
WEIGHT: 3.5 LB
MOUNTING HARDWARE: MCMASTER-CARR QUICK-RELEASE CLAMP PART # 5322K58 OR AN APPROVED EQUIVALENT

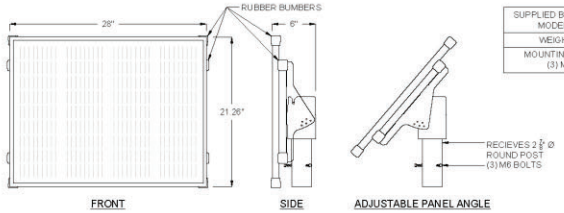
1 FLOCK AUTOMATIC LICENSE PLATE READER CAMERA
Scale: N/A



MANUFACTURER MCMASTER-CARR QUICK-RELEASE CLAMP PART # 5322K58 OR AN APPROVED EQUIVALENT
130 MPH WIND RATING

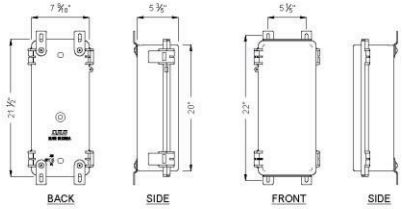
NOTE: LARGER DIAMETER POLES WILL USE AN EQUIVALENT 201 STAINLESS STEEL STRAPPING CUT TO LENGTH.

2 MOUNTING CLAMP
Scale: N/A



SUPPLIED BY FLOCK SAFETY
MODEL 702-00080
WEIGHT: 18 LB
MOUNTING HARDWARE: (3) M6 BOLTS

3 65 WATT SOLAR PANEL AND MOUNT ASSEMBLY (TOP MOUNTED)
Scale: N/A



SUPPLIED BY FLOCK SAFETY
MODEL 701-00111
WEIGHT: 3.5 LB (APPROX)
MOUNTING HARDWARE: MCMASTER-CARR QUICK-RELEASE CLAMP PART # 5322K58 OR AN APPROVED EQUIVALENT

4 EXTERNAL BATTERY PACK
SCALE: N/A

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flock safety
1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
0	09/05/2024	JMW	TYP DETAIL

LICENSE PLATE READER CAMERA INSTALLATION

SHEET:	REV:
SPEC.02	0

ITEM NO.	DESCRIPTION	QTY.
1	0.250-20 X 0.750 BT TX TAMPER-RESISTANT	8
2	2" SCH 40 2.375OD 0.154WALL - GALVANIZED STEEL	1
3	2.875OD X 0.203 WALL X 33.000L - 6061-T6 ALUMINUM	1
4	2.875OD X 0.203 WALL X 60.875L - 6061-T6 ALUMINUM	1
5	2.875OD X 0.203 WALL X 90.000L - 6063-T52 ALUMINUM	1
6	BRAIDED SLEEVE	1
7	BREAKAWAY ROUND POST 2.875OD	1
8	CONCRETE FOOTING	1
9	HBOLT ANTI ROTATION	1
10	INSERT SLEEVE STYLE 7 TAPPED	1
11	ORING SQ	1
12	WASHER 0.250 SPLIT LOCK 0.260 X 0.487 X 0.062	8
13	BOLT 0.250-20 X 3.500 X 0.750 HX BLACK WITH NUT 0.250-20 HX BLACK	1

PROVELI MASH DETAILS

BREAKAWAY STYLE 7 COUPLER ASSEMBLY

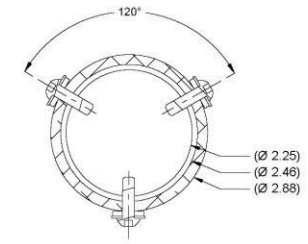
PART #: SP-7/MASH

MATERIAL: VARIES

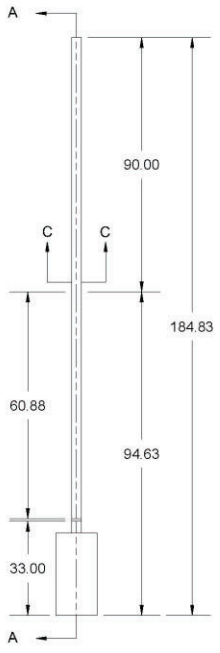
WEIGHT: 229.39 LBS

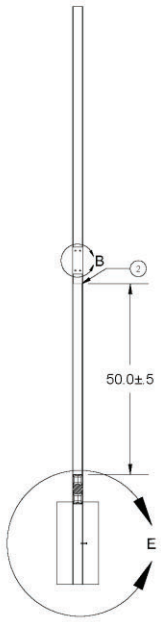
DATE: 01/11/2024

DO NOT SCALE DRAWINGS (NTS)

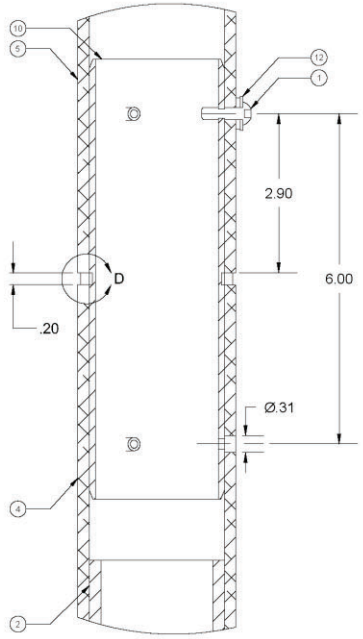


SECTION C-C

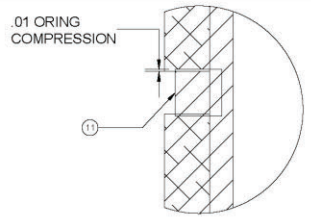




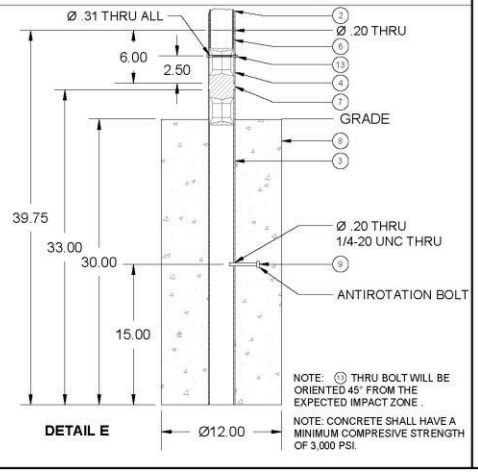
SECTION A-A



DETAIL B



DETAIL D



DETAIL E

flock safety

1170 HOWELL MILL ROAD SUITE 210
ATLANTA, GA 30318

REV	DATE	BY	DESCRIPTION
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
0	09/05/2024	JMW	TYP DETAIL

LICENSE PLATE READER CAMERA INSTALLATION

SHEET:	REV:
SPEC.03	0

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APPENDIX B.

SUPPORTING CERTIFICATION DOCUMENTS

Texas A&M Transportation Institute	QF 7.3-01 Concrete Sampling	Doc. No. QF 7.3-01	Revision Date: 2020-07-29
Quality Form	Revised by: B.L. Griffith Approved by: D. L. Kuhn	Revision: 7	Page: 1 of 1

Project No: 690900-PVL5-7 **Casting Date:** 9/17/2024 **Mix Design (psi):** 3000

Name of Technician Taking Sample	Terracon	Name of Technician Breaking Sample	Terracon
Signature of Technician Taking Sample	Terracon	Signature of Technician Breaking Sample	Terracon

Load No.	Truck No.	Ticket No.	Location (from concrete map)
T1	Castillo,Jul5	99297	100% of footers

Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average

TEXCRETE
Redi-mix Concrete Company

204896

REMIT PAYMENT TO:
P.O. BOX138
KURTEN, TX 77862

5222 Sandy Point RD.
Bryan, TX 77807

18935 Circle Lake Dr.
Pinehurst, TX 77362

17534 SH 6 South
College Station, TX 77845

17263 Hwy 75N
Willis, TX 77378

2687 HWY 105
Montgomery, TX 77333

PINEHURST DISPATCH - 936-232-5815
BCS DISPATCH - 979-316-2906
OFFICE - 979-985-3636

TEXAS A&M TRANSPORTATIO
RELLIS CAMPUS, BRYAN TX

RT 2818, RT HWY 21, LT SILVER HILL, RT AT THE "T", RT HWY 47, LT INTORELLIS ENTRANCE, STAY STRAIGHTALL THE WAY DOWN TO THE GATE

TIME	FORMULA	LOAD SIZE	YARD ORDERED		DRIVER/TRUCK		PLANT TRANSACTION#
12:06	CN940CC050	3.00	3.00	PO#	CASTILLO, JULS		99297
DATE		**LOAD#**	**YARDS DEL.**	**BATCH#**	**WATER TRIM**	**SLUMP**	**TICKET NUMBER**
9/17/24	PROJECT TTIRELL	3.00	3.00			5.00 in	97500

QUANTITY	CODE	DESCRIPTION	UNIT PRICE	EXTENDED PRICE
3.00 yd	CN940CC0500	COM, 4000, BLND, 5"		
1.00 ea	FUEL	Fuel Charge		

Thank you for your business

LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP.	AIR TEMP
12:17	12:35				

FINISH UNLOADING	LEFT JOB	ARRIVED AT PLANT	ON SITE TESTING
			TESTING LAB: TERRACON GESSNER CME OTHER

TESTED		AIR	CYLINDERS
☐ YES	☐ NO		

Tax
Prev. AMT
Ticket Total

ADDITIONAL CHARGE 1 _____

ADDITIONAL CHARGE 2 _____

GRAND TOTAL

WARNING
IRRITATING TO THE SKIN AND EYES

Contains Portland Cement. Wear Rubber Boots and Gloves. PROLONGED CONTACT MAY CAUSE BURNS. Avoid Contact With Eyes and Prolonged Contact with Skin. In Case of Contact with Skin or Eyes, Rinse Thoroughly With Water. If Irritation Persists, Get Medical Attention. **KEEP CHILDREN AWAY.**

CONCRETE is a PERISHABLE COMMODITY and BECOMES THE PROPERTY of the PURCHASER UPON LEAVING the PLANT. ANY CHANGES or CANCELLATION of ORIGINAL INSTRUCTIONS MUST be TELEPHONED to the OFFICE BEFORE LOADING starts. The undersigned promises to pay all costs, including reasonable attorney's fees, incurred in collecting any sums owed.

All accounts not paid within 30 days of delivery will bear interest at the rate of 18% per annum. Not Responsible For Reactive Aggregate or Color Quality. No Claim Allowed Unless Made at Time Material is Delivered.
A $25.00 Service Charge and Loss of the Cash Discounted will be Collected on all Returned Checks. Demurage charge after 90 min. will be $100.00/hr.

PROPERTY DAMAGE RELEASE
(TO BE SIGNED IF DELIVERY TO BE MADE INSIDE CURB LINE)

Dear Customer - The driver of this truck in presenting this RELEASE to you for your signature is of the opinion that the size and weight of this truck may possibly cause damage to the premises and/or adjacent property if he places the material in this load where you desire it. It is our wish to help you in everyway that we can, but in order to do this the driver is requesting that you sign this RELEASE relieving him and this supplier from any responsibility from damage that may occur to the premises and or adjacent property, buildings, sidewalks, driveways, curbs, etc. by the delivery of this material and that you also agree to help him remove mud from the wheels of his vehicle so that he will not liter the public streets. Further as additional consideration; the undersigned agrees to indemnify and hold harmless the driver of this truck and this supplier for any and all damage to the premises and /or adjacent property which may be claimed by anyone to have arisen out of delivery of this order

SIGNED:

X _____

Excessive Water is Detrimental to Concrete Performance.
H_2O Added by Request/Authorized By:

GAL X _____

WEIGHMASTER

Surcharge for credit cards

NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WHEN DELIVERING INSIDE CURB LINE.

LOAD RECEIVED BY

x _____

204896

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0310
Service Date: 09/17/24
Report Date: 10/24/24
Task: PO# 690900-PLV-7

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project
Riverside Campus
Riverside Campus
Bryan, TX

Project Number: A1171057

Material Information

Specified Strength:
Mix ID:
Supplier:
Batch Time: **Plant:**
Truck No.: **Ticket No.:**

Sample Information

Sample Date: 09/17/24 **Sample Time:**
Sampled By: Bryson Rodriguez
Weather Conditions: Clear, Light Wind
Accumulative Yards: 10/10 **Batch Size (cy):** 10
Placement Method: Direct Discharge
Water Added Before (gal): 0
Water Added After (gal): 0
Sample Location: Bottom of West Pier
Placement Location: 690900-PLV-7 Barrier Piers
Sample Description: 4-inch diameter cylinders

Field Test Data

Test	Result	Specification
Slump (in):	6	
Air Content (%):	2.1	
Concrete Temp. (F):	87	
Ambient Temp. (F):	90	
Plastic Unit Wt. (pcf):		
Yield (Cu. Yds.):		

Laboratory Test Data

Set No.	Spec ID	Cyl. Cond.	Avg Diam. (in)	Area (sq in)	Date Received	Date Tested	Age at Test (days)	Max Load (lbs)	Comp Strength (psi)	Frac Type	Tested By
1	A	Good	4.00	12.57	09/18/24	10/24/24	37	41,927	3,340	3	JLR
1	B	Good	4.00	12.57	09/18/24	10/24/24	37	43,922	3,490	3	JLR
1	C	Good	4.00	12.57	09/18/24	10/24/24	37	45,179	3,590	2	JLR
1	D	Good	4.00	12.57	09/18/24	10/24/24	37	42,657	3,390	3	JLR
							Average (37 days)		**3,460**		
1	E				09/18/24		Hold				

Initial Cure: Onsite Cooler **Final Cure:** Field Cured

Comments: **Not tested for plastic unit weight.**
Note: Reported air content does not include Aggregate Correction Factor (ACF).
Ticket was not obtained

Samples Made By: Terracon
Services: Obtain samples of fresh concrete at the placement locations (ASTM C 172), perform required field tests and cast, cure, and test compressive strength samples (ASTM C 31, C 39, C 1231).

Terracon Rep.: Bryson Rodriguez **Start/Stop:**
Reported To: Adam Mayer w/ TTI
Contractor:
Report Distribution:
(1) Texas Transportation Institute, Bill Griffith (1) Texas Transportation Institute, Adam Mayer

Reviewed By:
Justin Maass
Assistant Project Manager

Test Methods: ASTM C 31, ASTM C143, ASTM C231, ASTM C1064

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

APPENDIX C.

MASH TEST 3-60 (CRASH TEST 690900-PVL-5)

C.1. VEHICLE PROPERTIES AND INFORMATION

Date: 2024-09-27 Test No.: 690900-PVL-5 VIN No.: 3N1CN7APOKL815309

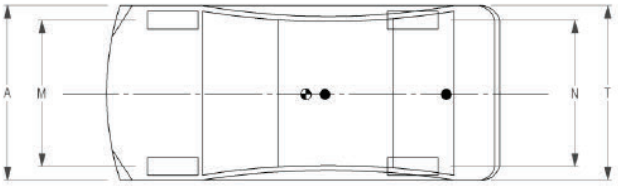
Year: 2019 Make: Nissan Model: Versa

Tire Inflation Pressure: 36 PSI Odometer: 85518 Tire Size: P185/65R15

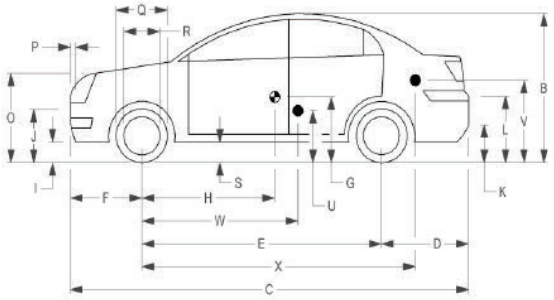
Describe any damage to the vehicle prior to test: None

● Denotes accelerometer location.

NOTES: None



Engine Type: 4 CYL
Engine CID: 1.6 L
Transmission Type:
☑ Auto or ☐ Manual
☑ FWD ☐ RWD ☐ 4WD
Optional Equipment:
None



Dummy Data:
Type: 50th Percentile Male
Mass: 165 lb
Seat Position: PASSENGER SIDE

Geometry: inches

A	66.70	F	32.50	K	12.50	P	4.50	U	15.50
B	59.60	G	0.00	L	26.00	Q	24.00	V	21.25
C	175.40	H	41.11	M	58.30	R	16.25	W	41.00
D	40.50	I	7.00	N	58.50	S	7.50	X	79.75
E	102.40	J	22.50	O	30.50	T	64.50		

Wheel Center Ht Front 11.50 Wheel Center Ht Rear 11.50 W-H -0.11

RANGE LIMIT: A = 65 ±3 inches; C = 169 ±8 inches; E = 98 ±5 inches; F = 35 ±4 inches; H = 39 ±4 inches; O (Top of Radiator Support) = 28 ±4 inches
(M+N)/2 = 59 ±2 inches; W-H < 2 inches or use MASH Paragraph A4.3.2

GVWR Ratings:		**Mass:** lb	Curb	Test Inertial	Gross Static
Front	1750	M_{front}	1436	1446	1531
Back	1687	M_{rear}	996	970	1050
Total	3389	M_{Total}	2432	2416	2581

Allowable TIM = 2420 lb ±55 lb | Allowable GSM = 2585 lb ± 55 lb

Mass Distribution:
lb LF: 706 RF: 740 LR: 501 RR: 469

Figure C.1. Vehicle Properties for Test 690900-PVL-5.

Date:	2024-09-27	Test No.:	690900-PVL-5	VIN No.:	3N1CN7APOKL815309
Year:	2019	Make:	Nissan	Model:	Versa

VEHICLE CRUSH MEASUREMENT SHEET[1]

Complete When Applicable	
End Damage	Side Damage
Undeformed end width _____	Bowing: B1 _____ X1 _____
Corner shift: A1 _____	B2 _____ X2 _____
A2 _____	
End shift at frame (CDC)	Bowing constant
(check one)	$\frac{X1+X2}{2}$ = _____
< 4 inches _____	
≥ 4 inches _____	

Note: Measure C_1 to C_6 from Driver to Passenger Side in Front or Rear Impacts – Rear to Front in Side Impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width** (CDC)	Max*** Crush								
-	-	-	-	-	-	-	-	-	-	-	-
	Measurements recorded										
	☑ inches or ☐ mm										

[1]Table taken from National Accident Sampling System (NASS).

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

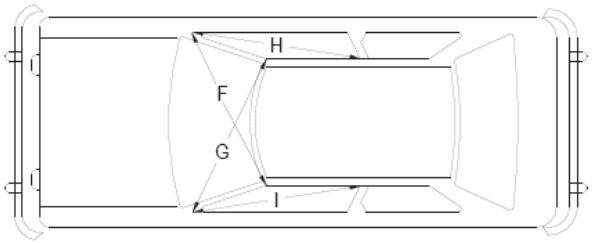
**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle).

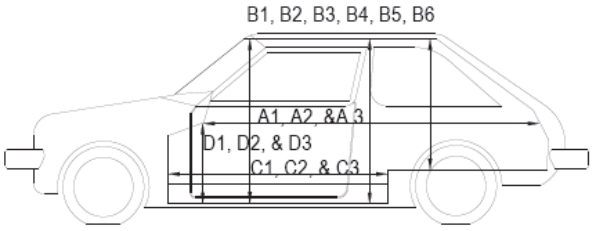
***Measure and document on the vehicle diagram the location of the maximum crush.

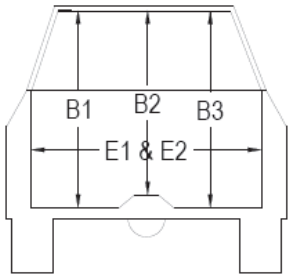
Note: Use as many lines/columns as necessary to describe each damage profile.

Figure C.2. Exterior Crush Measurements for Test 690900-PVL-5.

Date:	2024-09-27	Test No.:	690900-PVL-5	VIN No.:	3N1CN7APOKL815309
Year:	2019	Make:	Nissan	Model:	Versa







OCCUPANT COMPARTMENT DEFORMATION MEASUREMENT

	Before	After (inches)	Differ.
A1	67.50	67.50	0.00
A2	67.25	67.25	0.00
A3	67.75	67.75	0.00
B1	40.50	40.50	0.00
B2	39.00	39.00	0.00
B3	40.50	40.50	0.00
B4	36.25	36.25	0.00
B5	36.00	36.00	0.00
B6	36.25	36.25	0.00
C1	26.00	26.00	0.00
C2	0.00	0.00	0.00
C3	26.00	26.00	0.00
D1	9.50	9.50	0.00
D2	0.00	0.00	0.00
D3	9.50	9.50	0.00
E1	51.50	51.50	0.00
E2	51.00	51.00	0.00
F	51.00	51.00	0.00
G	51.00	51.00	0.00
H	37.50	37.50	0.00
I	37.50	37.50	0.00
J*	51.00	51.00	0.00

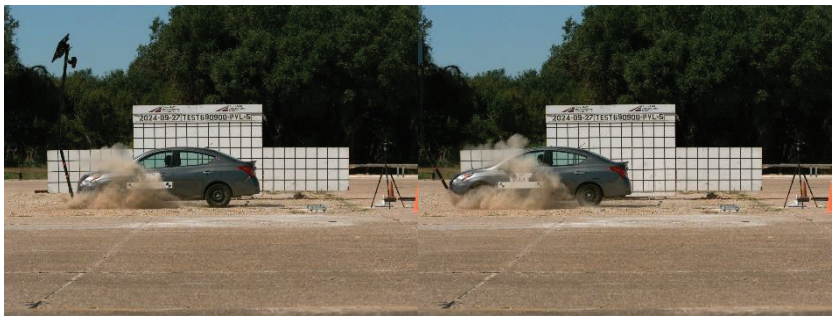
*Lateral area across the cab from driver's side kick panel to passenger's side kick panel.

Figure C.3. Occupant Compartment Measurements for Test 690900-PVL-5.

C.2. SEQUENTIAL PHOTOGRAPHS

(a) 0.000 s (b) 0.1500 s

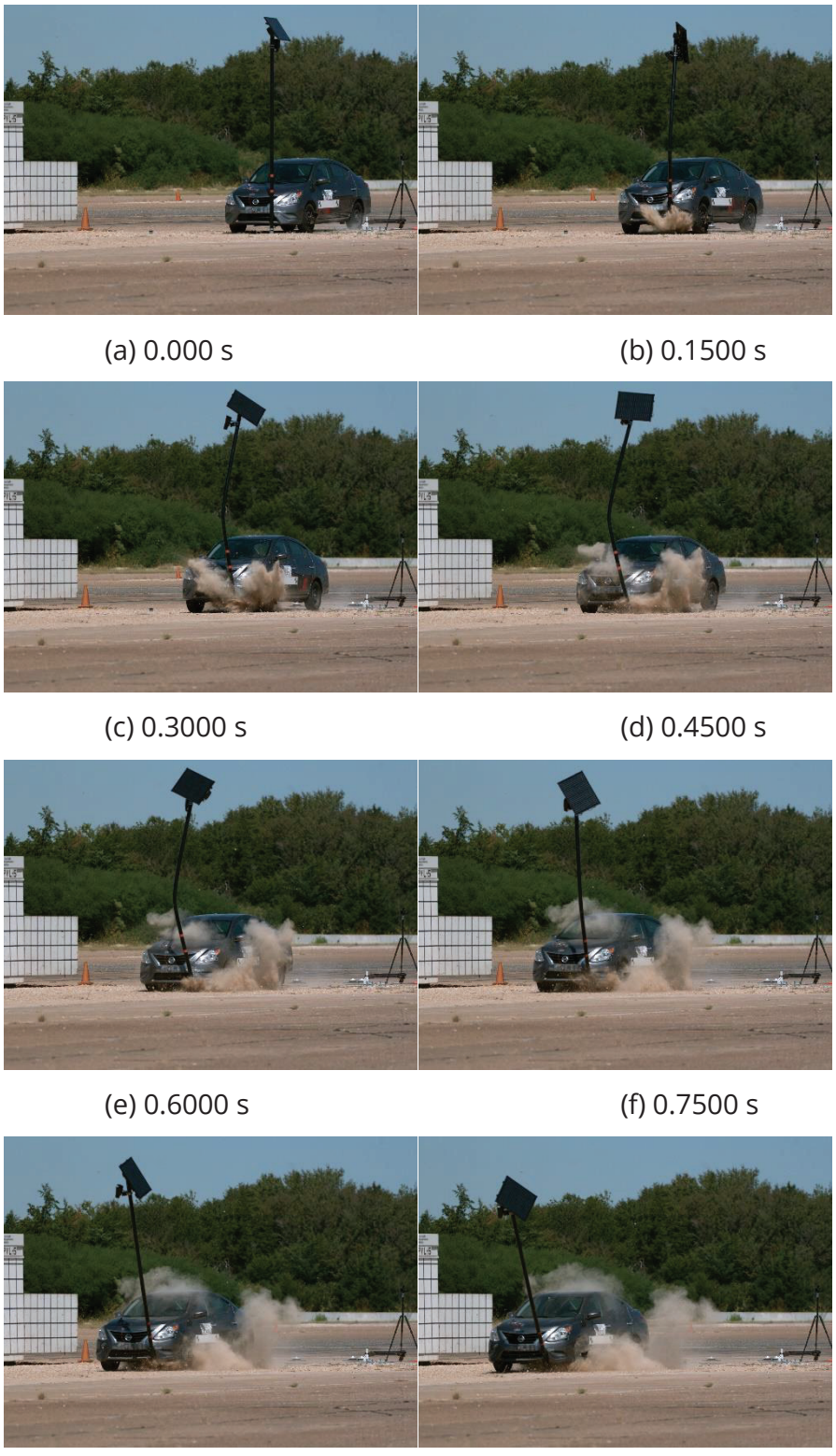
(c) 0.3000 s (d) 0.4500 s



(e) 0.6000 s (f) 0.7500 s

(g) 0.9000 s (h) 1.0500 s

Figure C.4. Sequential Photographs for Test 690900-PVL-5 (Right Angle Views).



(a) 0.000 s (b) 0.1500 s

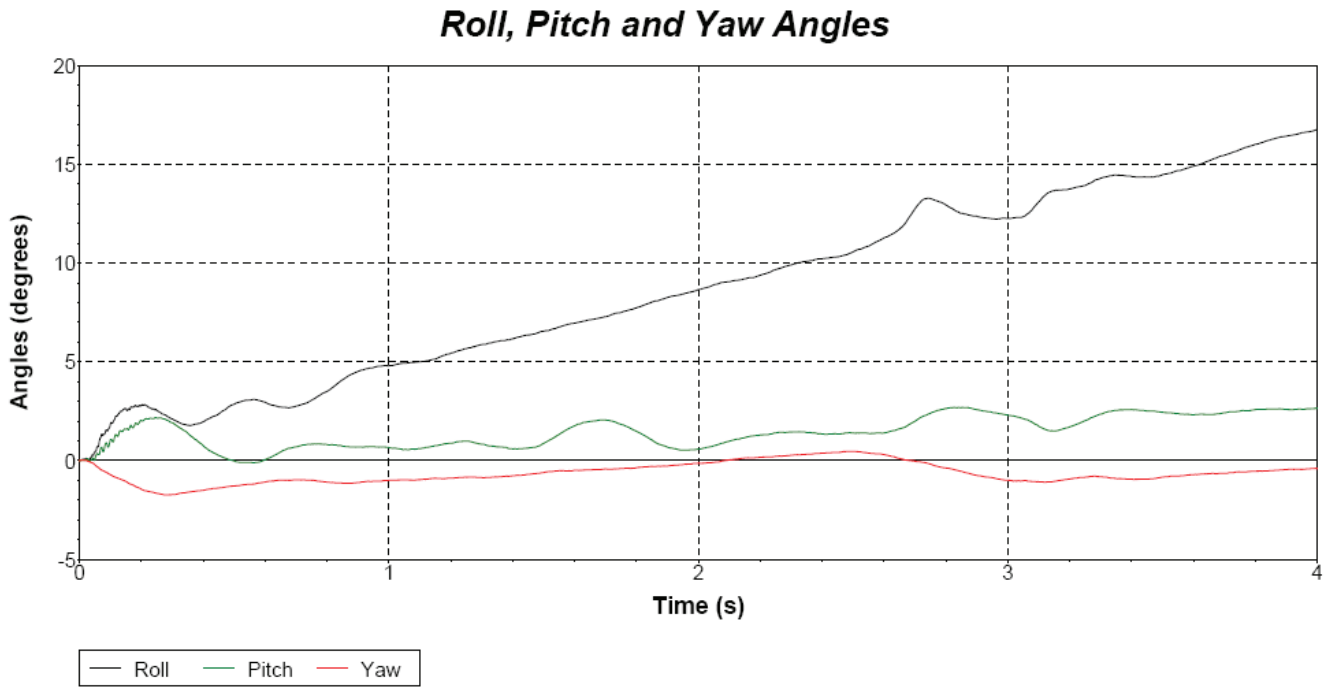
(c) 0.3000 s (d) 0.4500 s

(e) 0.6000 s (f) 0.7500 s

(g) 0.9000 s (h) 1.0500 s

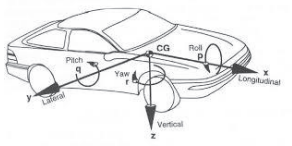
Figure C.5. Sequential Photographs for Test 690900-PVL-5 (Downstream Oblique Views).

C.3. VEHICLE ANGULAR DISPLACEMENTS



Axes are vehicle-fixed.
Sequence for determining orientation:

1. Yaw.
2. Pitch.
3. Roll



Test Number: 690900-PVL-5
Test Standard Test Number: *MASH* Test 3-60
Test Article: Breakaway Pole System
Test Vehicle: 2019 Nissan Versa
Inertial Mass: 2441 lbs
Gross Mass: 2606 lbs
Impact Speed: 18.8 mi/h
Impact Angle: 0°

Figure C.6. Vehicle Angular Displacements for Test 690900-PVL-5.

C.4. VEHICLE ACCELERATIONS

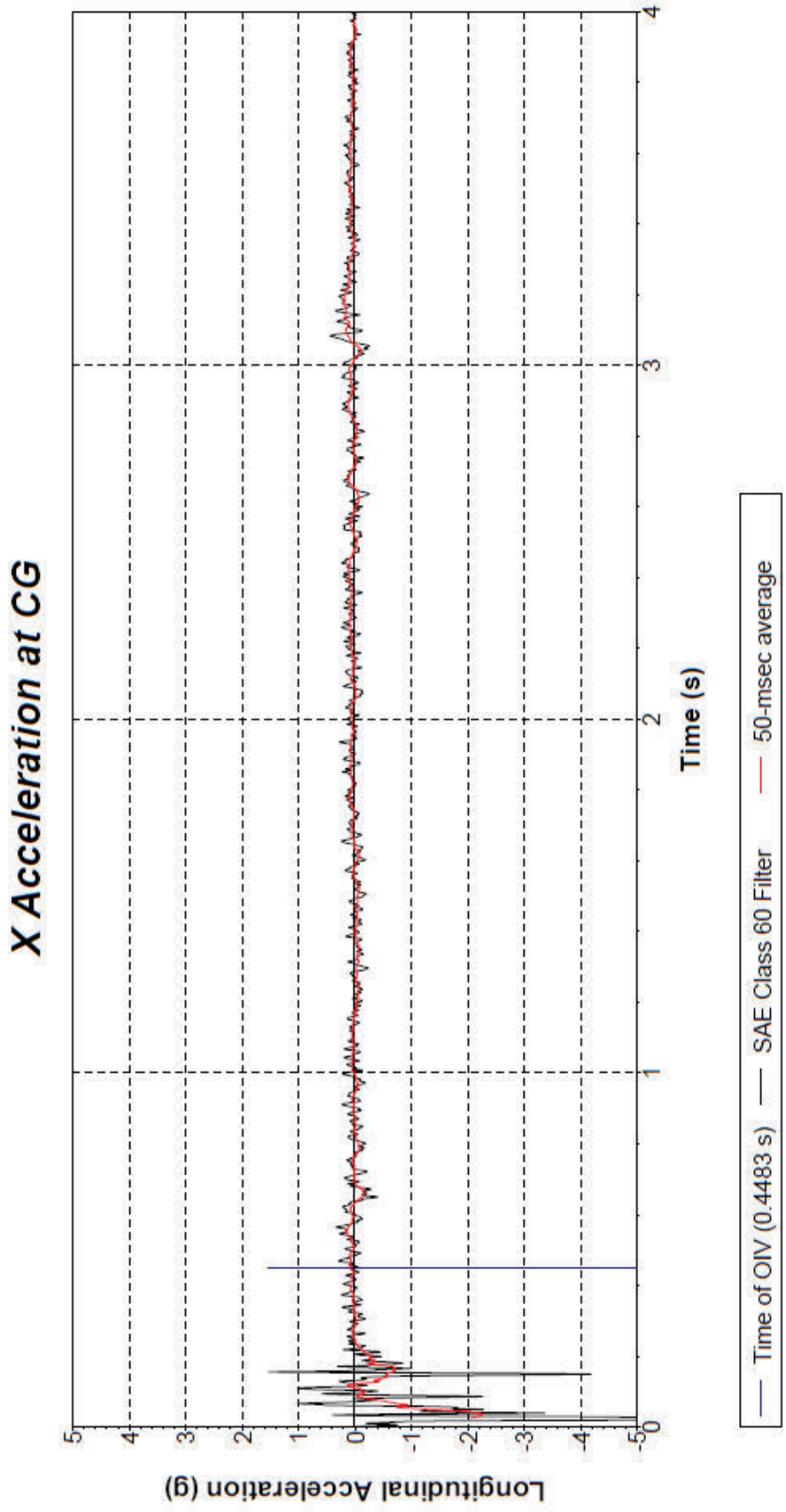


Figure C.7. Vehicle Longitudinal Accelerometer Trace for Test 690900-PVL-5 (Accelerometer Located at Center of Gravity).

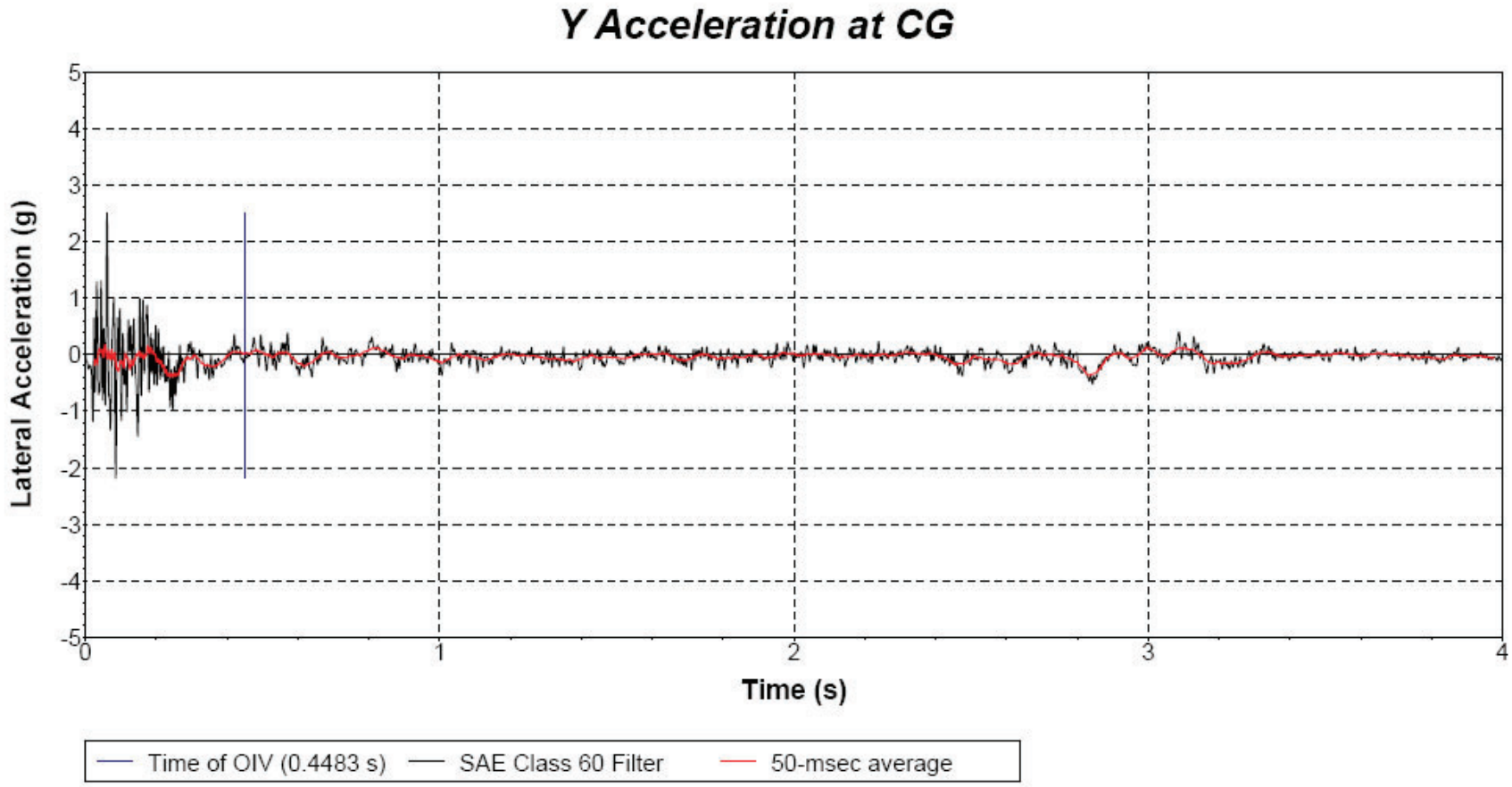


Figure C.8. Vehicle Lateral Accelerometer Trace for Test 690900-PVL-5 (Accelerometer Located at Center of Gravity).

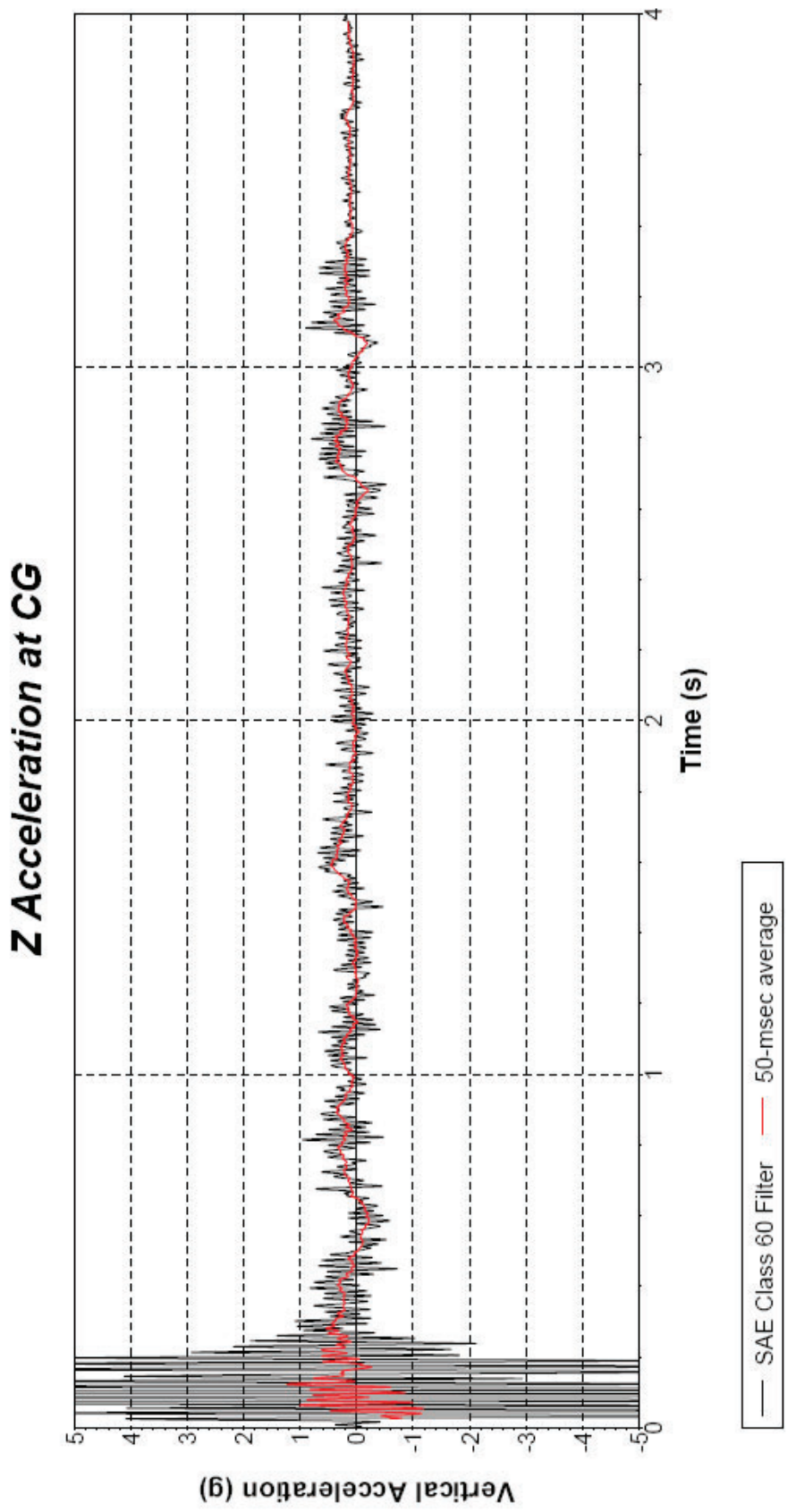


Figure C.9. Vehicle Vertical Accelerometer Trace for Test 690900-PVL-5 (Accelerometer Located at Center of Gravity).

APPENDIX D.

MASH TEST 3-61
(CRASH TEST 690900-PVL-6)

D.1. VEHICLE PROPERTIES AND INFORMATION

Date: 2024-09-27 Test No.: 690900-PVL-6 VIN No.: 3N1CN7APOKL815309

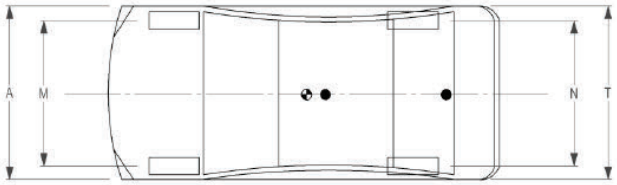
Year: 2019 Make: Nissan Model: Versa

Tire Inflation Pressure: 36 PSI Odometer: 85519 Tire Size: P185/65R15

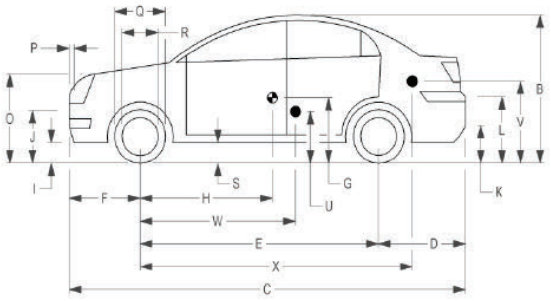
Describe any damage to the vehicle prior to test: None

• Denotes accelerometer location.

NOTES: None



Engine Type: 4 CYL
Engine CID: 1.6 L
Transmission Type:
☑ Auto or ☐ Manual
☑ FWD ☐ RWD ☐ 4WD
Optional Equipment:
None



Dummy Data:
Type: 50th Percentile Male
Mass: 165 lb
Seat Position: DRIVERS SIDE

Geometry: inches

A	66.70	F	32.50	K	12.50	P	4.50	U	15.50
B	59.60	G	0.00	L	26.00	Q	24.00	V	21.25
C	175.40	H	41.11	M	58.30	R	16.25	W	41.00
D	40.50	I	7.00	N	58.50	S	7.50	X	79.75
E	102.40	J	22.50	O	30.50	T	64.50		

Wheel Center Ht Front 11.50 Wheel Center Ht Rear 11.50 W-H -0.11

RANGE LIMIT: A = 65 ±3 inches; C = 169 ±8 inches; E = 98 ±5 inches; F = 35 ±4 inches; H = 39 ±4 inches; O (Top of Radiator Support) = 28 ±4 inches
(M+N)/2 = 59 ±2 inches; W-H < 2 inches or use MASH Paragraph A4.3.2

GVWR Ratings:	Mass: lb	Curb	Test Inertial	Gross Static
Front 1750	M_{front}	1436	1446	1531
Back 1687	M_{rear}	996	970	1050
Total 3389	M_{Total}	2432	2416	2581

Allowable TIM = 2420 lb ±55 lb | Allowable GSM = 2585 lb ± 55 lb

Mass Distribution:
lb LF: 706 RF: 740 LR: 501 RR: 469

Figure D.1. Vehicle Properties for Test 690900-PVL-6.

Date:	2024-09-27	Test No.:	690900-PVL-6	VIN No.:	3N1CN7APOKL815309
Year:	2019	Make:	Nissan	Model:	Versa

VEHICLE CRUSH MEASUREMENT SHEET[1]

Complete When Applicable	
End Damage	Side Damage
Undeformed end width _____	Bowing: B1 _____ X1 _____
Corner shift: A1 _____	B2 _____ X2 _____
A2 _____	
End shift at frame (CDC)	Bowing constant
(check one)	$\frac{X1+X2}{2} =$ _____
< 4 inches _____	
≥ 4 inches _____	

Note: Measure C_1 to C_6 from Driver to Passenger Side in Front or Rear Impacts – Rear to Front in Side Impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width** (CDC)	Max*** Crush								
1	AT FRONT BUMPER	17	10	20	-	-	-	-	-	-	+18
2	AT HOOD	24	7	10	-	-	-	-	-	-	23
	Measurements recorded										
	☑ inches or ☐ mm										

[1]Table taken from National Accident Sampling System (NASS).

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

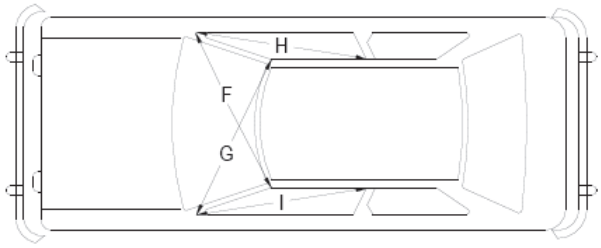
**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle).

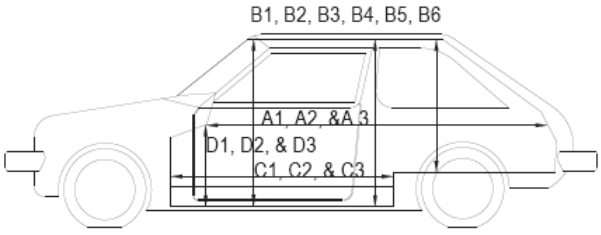
***Measure and document on the vehicle diagram the location of the maximum crush.

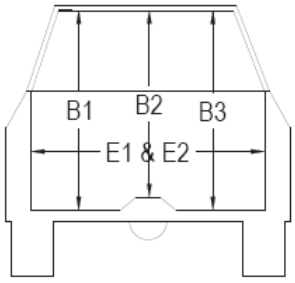
Note: Use as many lines/columns as necessary to describe each damage profile.

Figure D.2. Exterior Crush Measurements for Test 690900-PVL-6.

Date:	2024-09-27	Test No.:	690900-PVL-6	VIN No.:	3N1CN7APOKL815309
Year:	2019	Make:	Nissan	Model:	Versa







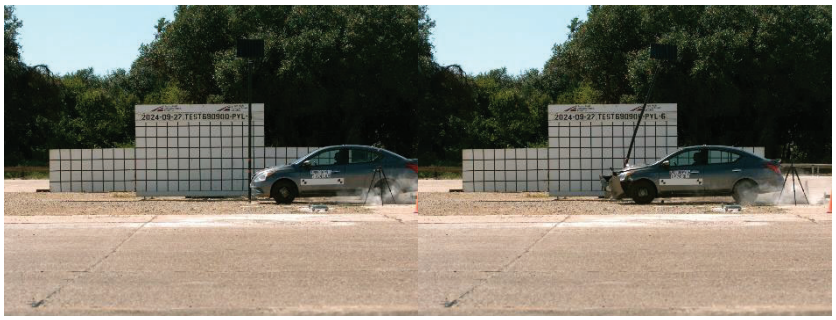
OCCUPANT COMPARTMENT DEFORMATION MEASUREMENT

	Before	After (inches)	Differ.
A1	67.50	67.50	0.00
A2	67.25	67.25	0.00
A3	67.75	67.75	0.00
B1	40.50	40.50	0.00
B2	39.00	39.00	0.00
B3	40.50	40.50	0.00
B4	36.25	36.25	0.00
B5	36.00	36.00	0.00
B6	36.25	36.25	0.00
C1	26.00	26.00	0.00
C2	0.00	0.00	0.00
C3	26.00	26.00	0.00
D1	9.50	9.50	0.00
D2	0.00	0.00	0.00
D3	9.50	9.50	0.00
E1	51.50	51.50	0.00
E2	51.00	51.00	0.00
F	51.00	51.00	0.00
G	51.00	51.00	0.00
H	37.50	37.50	0.00
I	37.50	37.50	0.00
J*	51.00	51.00	0.00

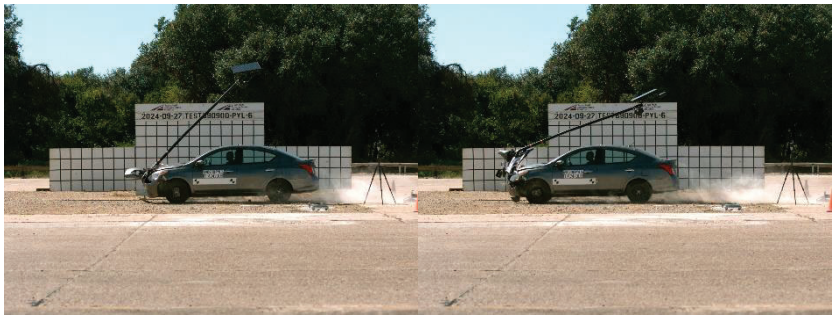
*Lateral area across the cab from driver's side kick panel to passenger's side kick panel.

Figure D.3. Occupant Compartment Measurements for Test 690900-PVL-6.

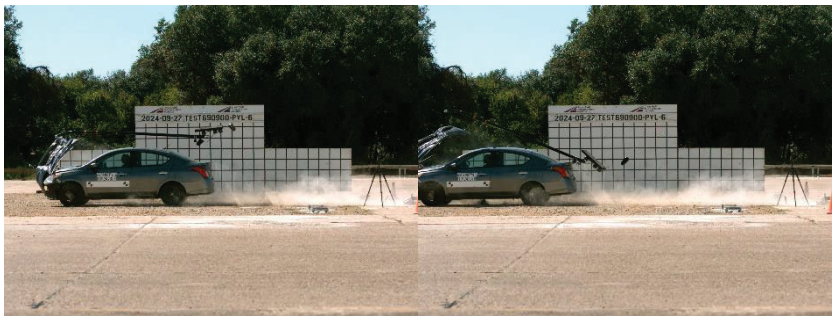
D.2. SEQUENTIAL PHOTOGRAPHS



(a) 0.000 s (b) 0.0500 s



(c) 0.1000 s (d) 0.1500 s



(e) 0.2000 s (f) 0.2500 s

(g) 0.3000 s (h) 0.3500 s

Figure D.4. Sequential Photographs for Test 690900-PVL-6 (Right Angle Views).

(a) 0.000 s (b) 0.0500 s

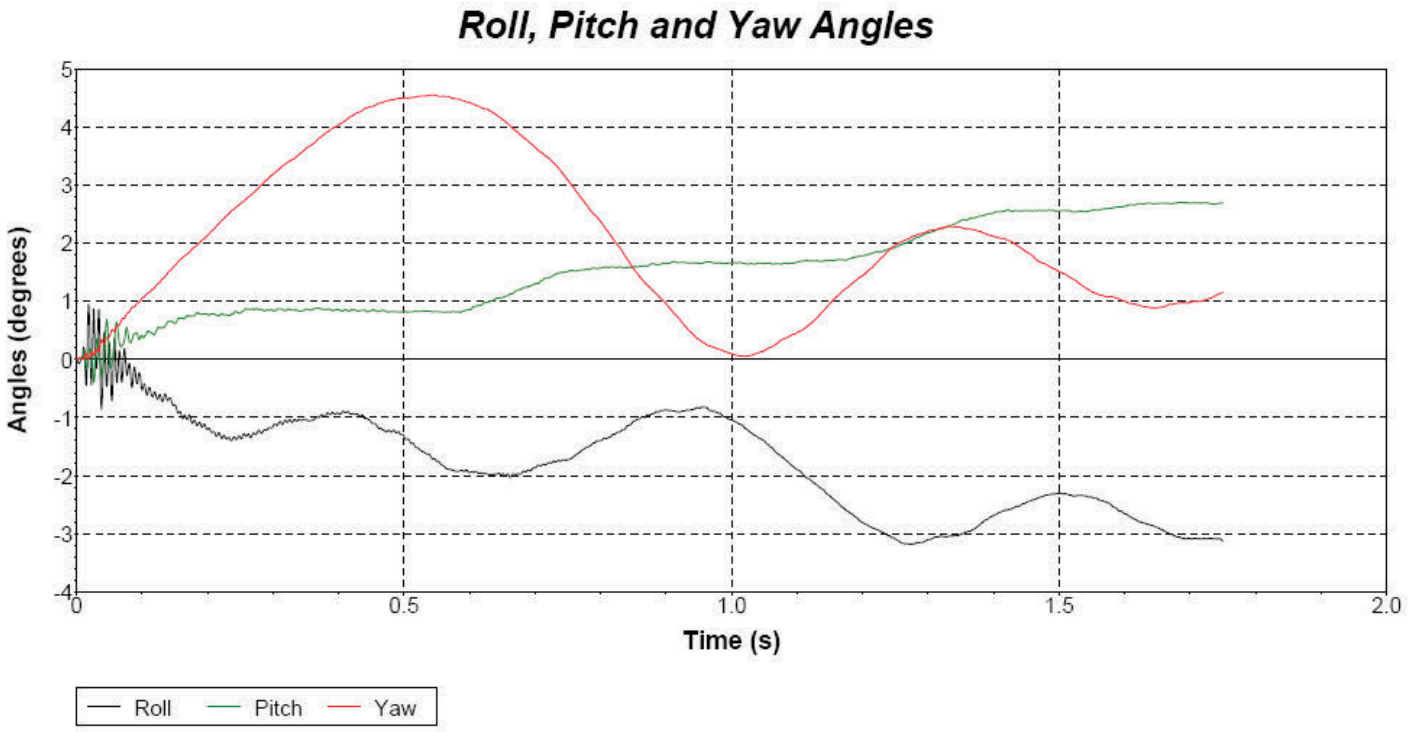
(c) 0.1000 s (d) 0.1500 s

(e) 0.2000 s (f) 0.2500 s

(g) 0.3000 s (h) 0.3500 s

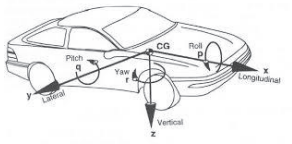
Figure D.5. Sequential Photographs for Test 690900-PVL-6 (Downstream Oblique Views).

D.3. VEHICLE ANGULAR DISPLACEMENTS



Axes are vehicle-fixed.
Sequence for determining orientation:

4. Yaw.
5. Pitch.
6. Roll.



Test Number: 690900-PVL-6
Test Standard Test Number: *MASH* Test 3-61
Test Article: Breakaway Pole System
Test Vehicle: 2019 Nissan Versa
Inertial Mass: 2441 lbs
Gross Mass: 2606 lbs
Impact Speed: 62.3 mi/h
Impact Angle: 0°

Figure D.6. Vehicle Angular Displacements for Test 690900-PVL-6.

D.4. VEHICLE ACCELERATIONS

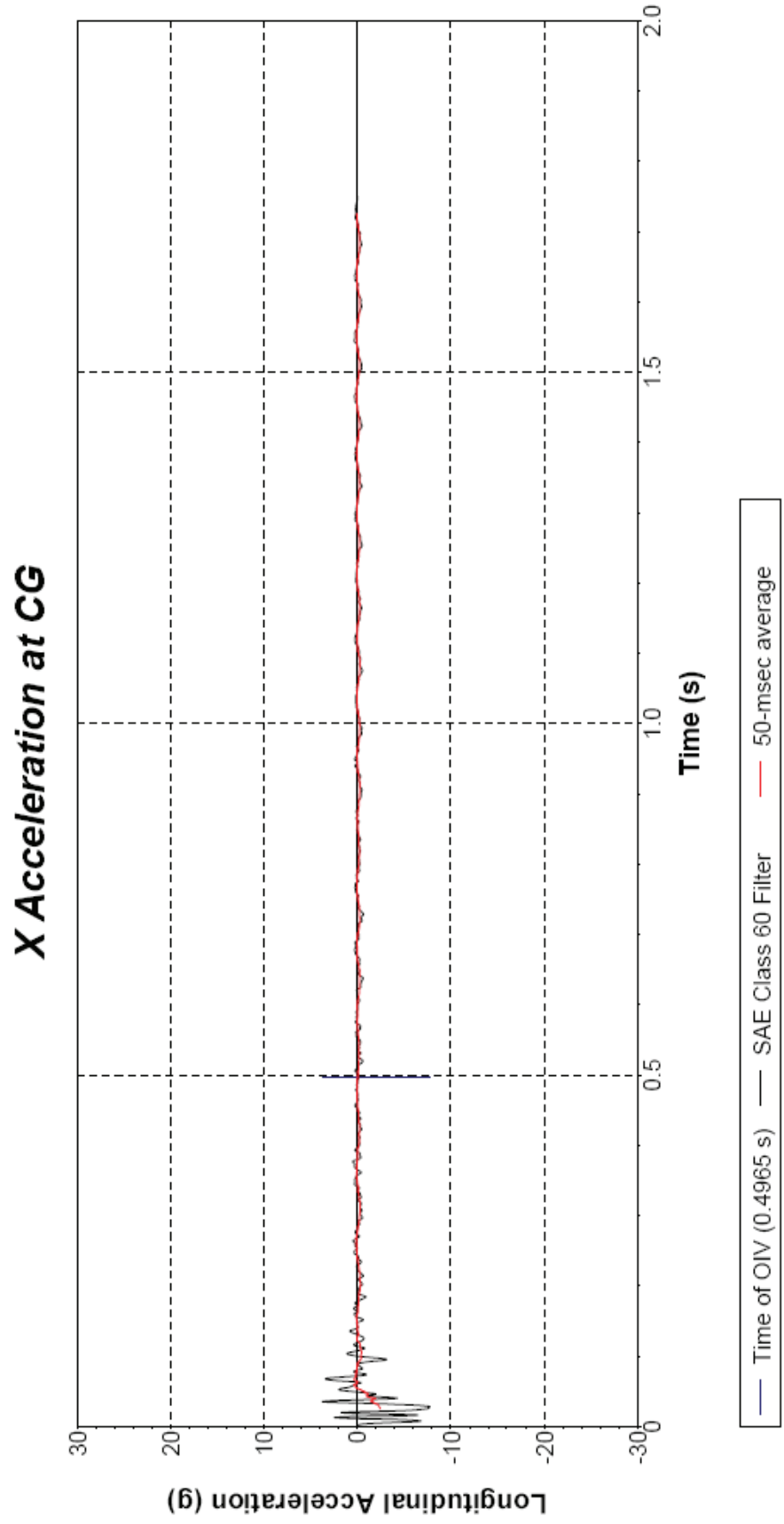


Figure D.7. Vehicle Longitudinal Accelerometer Trace for Test 690900-PVL-6 (Accelerometer Located at Center of Gravity).

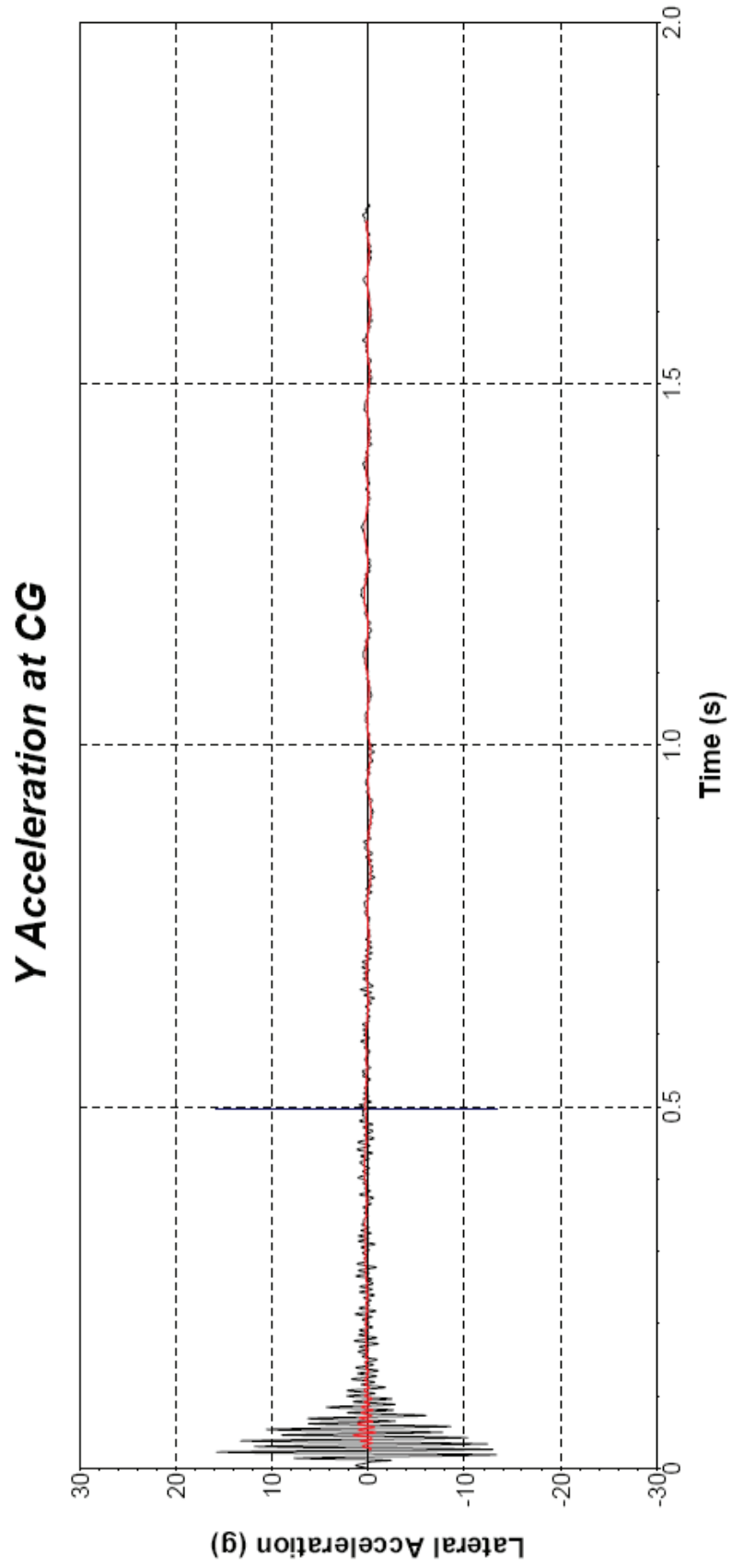


Figure D.8. Vehicle Lateral Accelerometer Trace for Test 690900-PVL-6 (Accelerometer Located at Center of Gravity).

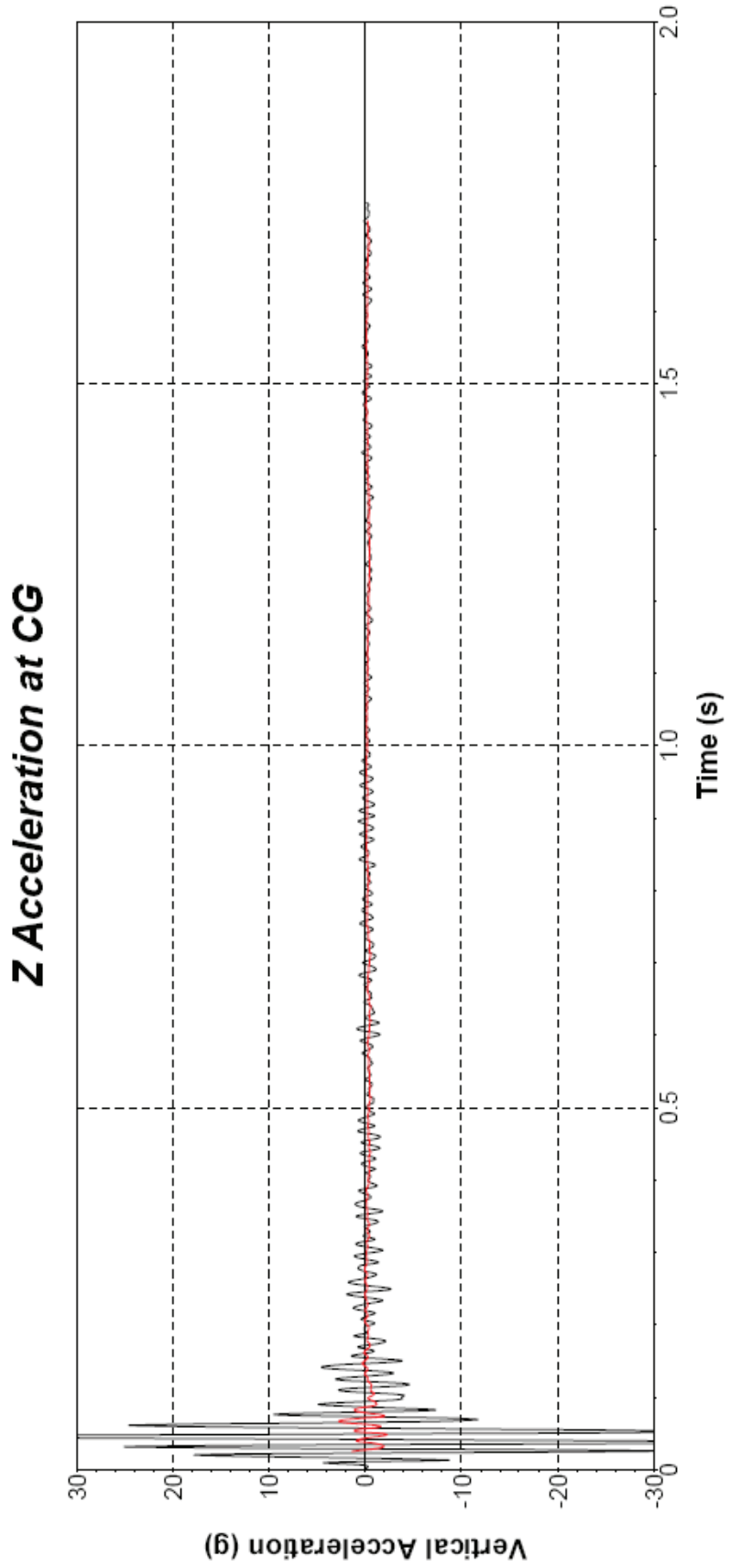


Figure D.9. Vehicle Vertical Accelerometer Trace for Test 690900-PVL-6 (Accelerometer Located at Center of Gravity).

APPENDIX E.

MASH TEST 3-62
(CRASH TEST 690900-PVL-7)

E.1. VEHICLE PROPERTIES AND INFORMATION

Date: 2024-09-27 Test No.: 690900-PVL-7 VIN No.: 1C6RR6FT2JS188633

Year: 2018 Make: RAM Model: 1500

Tire Size: 265/70 R 17 Tire Inflation Pressure: 35 psi

Tread Type: Highway Odometer: 131964

Note any damage to the vehicle prior to test: None

● Denotes accelerometer location.

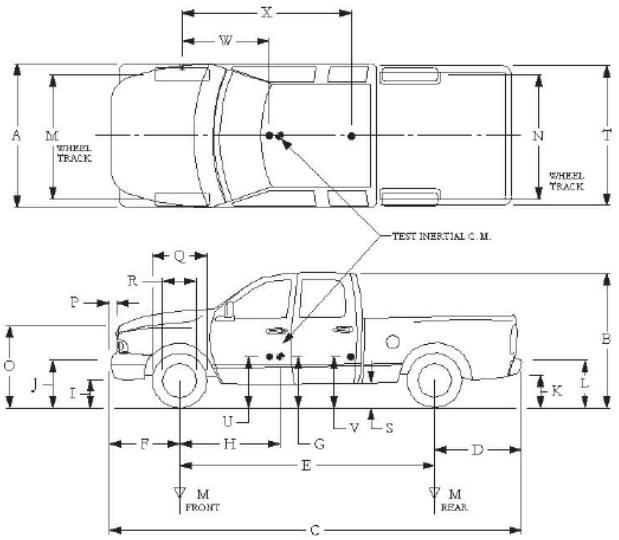
NOTES: None

Engine Type: V-8
Engine CID: 5.7 liter

Transmission Type:
☑ Auto or ☐ Manual
☐ FWD ☑ RWD ☐ 4WD

Optional Equipment:
None

Dummy Data:
Type:
Mass:
Seat Position:



Geometry: inches

A	78.50	F	40.25	K	20.00	P	3.00	U	26.75		
B	74.00	G	28.75	L	30.00	Q	30.50	V	30.25		
C	229.00	H	62.10	M	68.50	R	18.00	W	62.00		
D	48.25	I	11.75	N	68.00	S	13.00	X	79.00		
E	140.50	J	27.00	O	46.00	T	77.00				
Wheel Center Height Front	14.75			Wheel Well Clearance (Front)	6.00			Bottom Frame Height - Front	12.50		
Wheel Center Height Rear	14.75			Wheel Well Clearance (Rear)	9.25			Bottom Frame Height - Rear	22.50		

RANGE LIMIT: A=78 ±2 inches; C=237 ±13 inches; E=148 ±12 inches; F=39 ±3 inches; G = > 28 inches; H = 63 ±4 inches; O=43 ±4 inches; (M+N)/2=67 ±1.5 inches

GVWR Ratings:		Mass: lb	Curb	Test Inertial	Gross Static
Front	3700	M_{front}	2913	2807	2807
Back	3900	M_{rear}	2072	2224	2224
Total	6700	M_{Total}	4985	5031	5031

(Allowable Range for TIM and GSM = 5000 lb ±110 lb)

Mass Distribution:
lb LF: 1407 RF: 1400 LR: 1111 RR: 1113

Figure E.1. Vehicle Properties for Test 690900-PVL-7.

Date: 2024-09-27 Test No.: 690900-PVL-7 VIN No.: 1C6RR6FT2JS188633

Year: 2018 Make: RAM Model: 1500

VEHICLE CRUSH MEASUREMENT SHEET[1]

Complete When Applicable	
End Damage	Side Damage
Undeformed end width _____	Bowing: B1 _____ X1 _____
Corner shift: A1 _____	B2 _____ X2 _____
A2 _____	
End shift at frame (CDC)	Bowing constant
(check one)	$\frac{X1+X2}{2}$ = _____
< 4 inches _____	
≥ 4 inches _____	

Note: Measure C_1 to C_6 from Driver to Passenger Side in Front or Rear Impacts – Rear to Front in Side Impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width** (CDC)	Max*** Crush								
1	AT FRONT BUMPER	19	8	20	-	-	-	-	-	-	-27
	Measurements recorded										
	☑ inches or ☐ mm										

[1]Table taken from National Accident Sampling System (NASS).

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

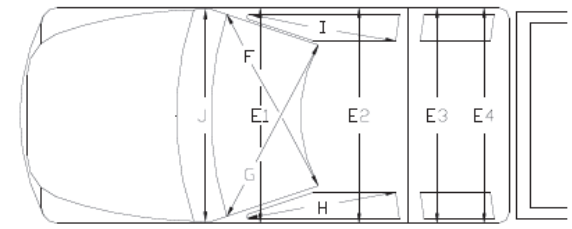
**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle).

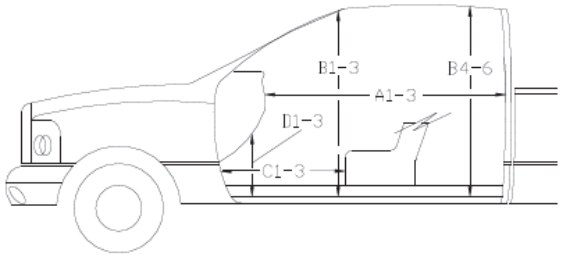
***Measure and document on the vehicle diagram the location of the maximum crush.

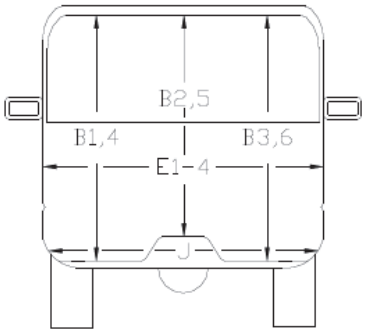
Note: Use as many lines/columns as necessary to describe each damage profile.

Figure E.2. Exterior Crush Measurements for Test 690900-PVL-7.

Date:	2024-09-27	Test No.:	690900-PVL-7	VIN No.:	1C6RR6FT2JS188633
Year:	2018	Make:	RAM	Model:	1500







*Lateral area across the cab from driver's side kickpanel to passenger's side kickpanel.

OCCUPANT COMPARTMENT DEFORMATION MEASUREMENT

	Before	After (inches)	Differ.
A1	65.00	65.00	0.00
A2	63.00	63.00	0.00
A3	65.50	65.50	0.00
B1	45.00	42.25	-2.75
B2	38.00	38.00	0.00
B3	45.00	45.00	0.00
B4	39.50	39.50	0.00
B5	43.00	43.00	0.00
B6	39.50	39.50	0.00
C1	26.00	26.00	0.00
C2	0.00	0.00	0.00
C3	26.00	26.00	0.00
D1	11.00	11.00	0.00
D2	0.00	0.00	0.00
D3	11.50	11.50	0.00
E1	58.50	58.50	0.00
E2	63.50	63.50	0.00
E3	63.50	63.50	0.00
E4	63.50	63.50	0.00
F	59.00	59.00	0.00
G	59.00	59.00	0.00
H	37.50	37.50	0.00
I	37.50	37.50	0.00
J*	25.00	25.00	0.00

Figure E.3. Occupant Compartment Measurements for Test 690900-PVL-7.

E.2. SEQUENTIAL PHOTOGRAPHS

(a) 0.000 s (b) 0.0500 s

(c) 0.1000 s (d) 0.1500 s

(e) 0.2000 s (f) 0.2500 s

(g) 0.3000 s (h) 0.3500 s

Figure E.4. Sequential Photographs for Test 690900-PVL-7 (Right Angle Views).

(a) 0.000 s (b) 0.0500 s

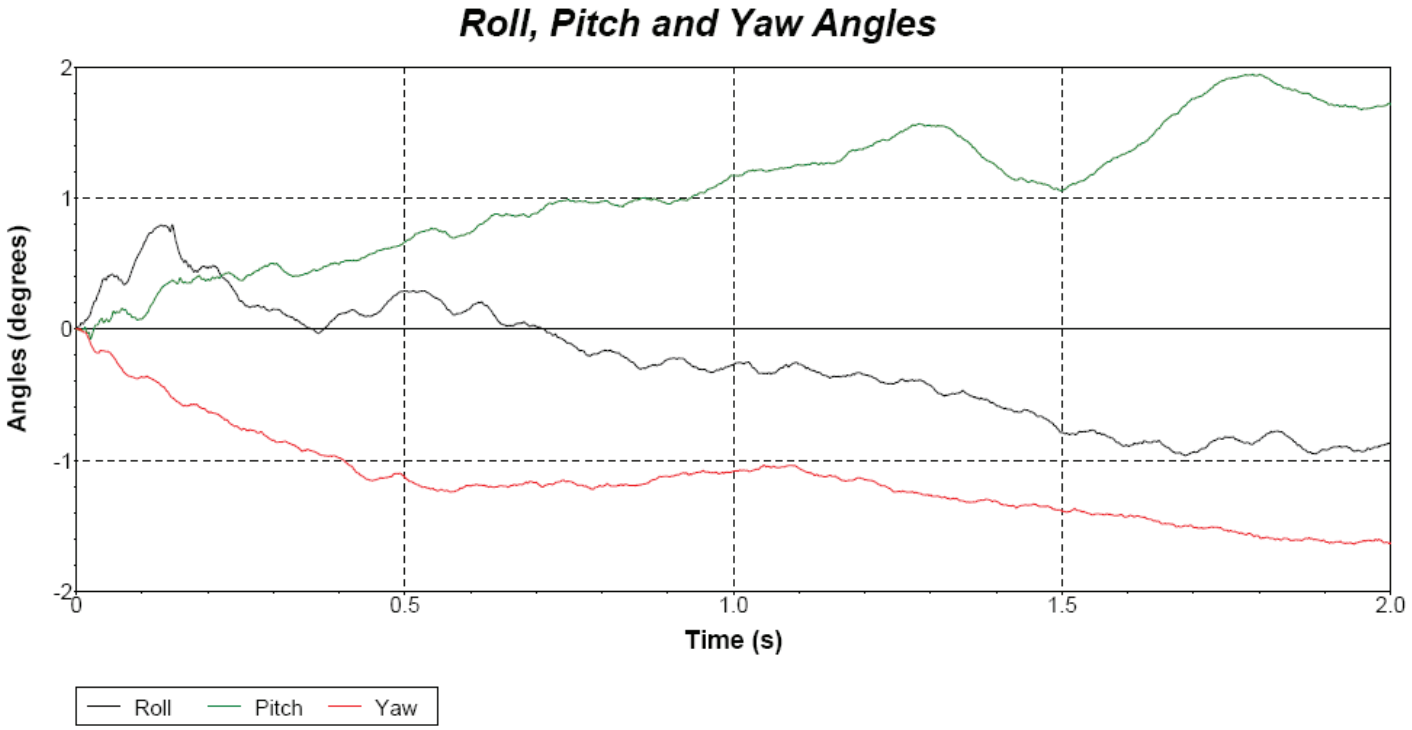
(c) 0.1000 s (d) 0.1500 s

(e) 0.2000 s (f) 0.2500 s

(g) 0.3000 s (h) 0.3500 s

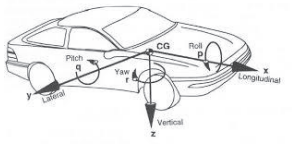
Figure E.5. Sequential Photographs for Test 690900-PVL-7 (Downstream Oblique Views).

E.3. VEHICLE ANGULAR DISPLACEMENTS



Axes are vehicle-fixed.
Sequence for determining orientation:

7. Yaw.
8. Pitch.
9. Roll.



Test Number: 690900-PVL-7
Test Standard Test Number: *MASH* Test 3-62
Test Article: Breakaway Pole System
Test Vehicle: 2018 RAM 1500
Inertial Mass: 5031 lbs
Gross Mass: 5031 lbs
Impact Speed: 62.7 mi/h
Impact Angle: 0°

Figure E.6. Vehicle Angular Displacements for Test 690900-PVL-7.

E.4. VEHICLE ACCELERATIONS

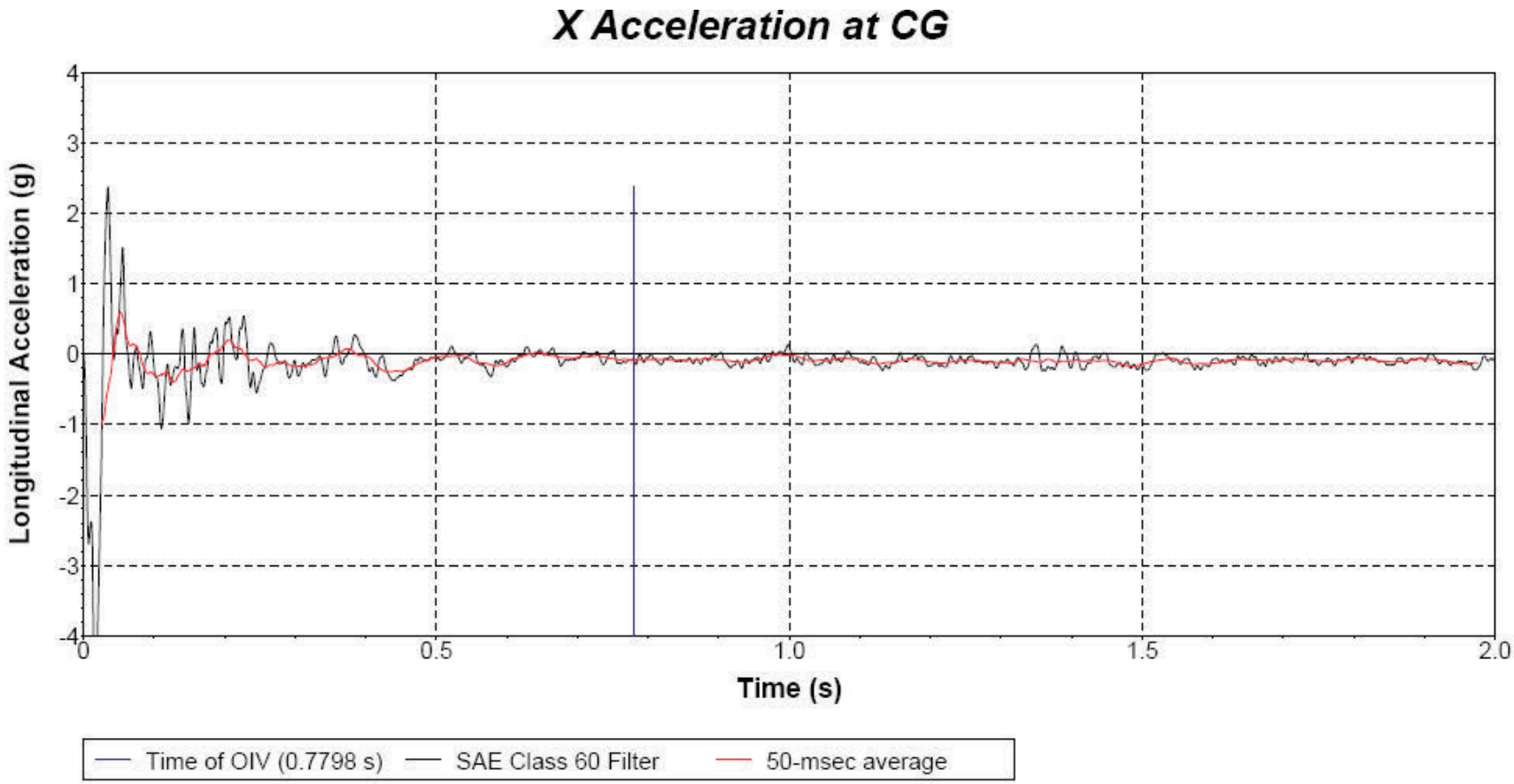


Figure E.7. Vehicle Longitudinal Accelerometer Trace for Test 690900-PVL-7 (Accelerometer Located at Center of Gravity).

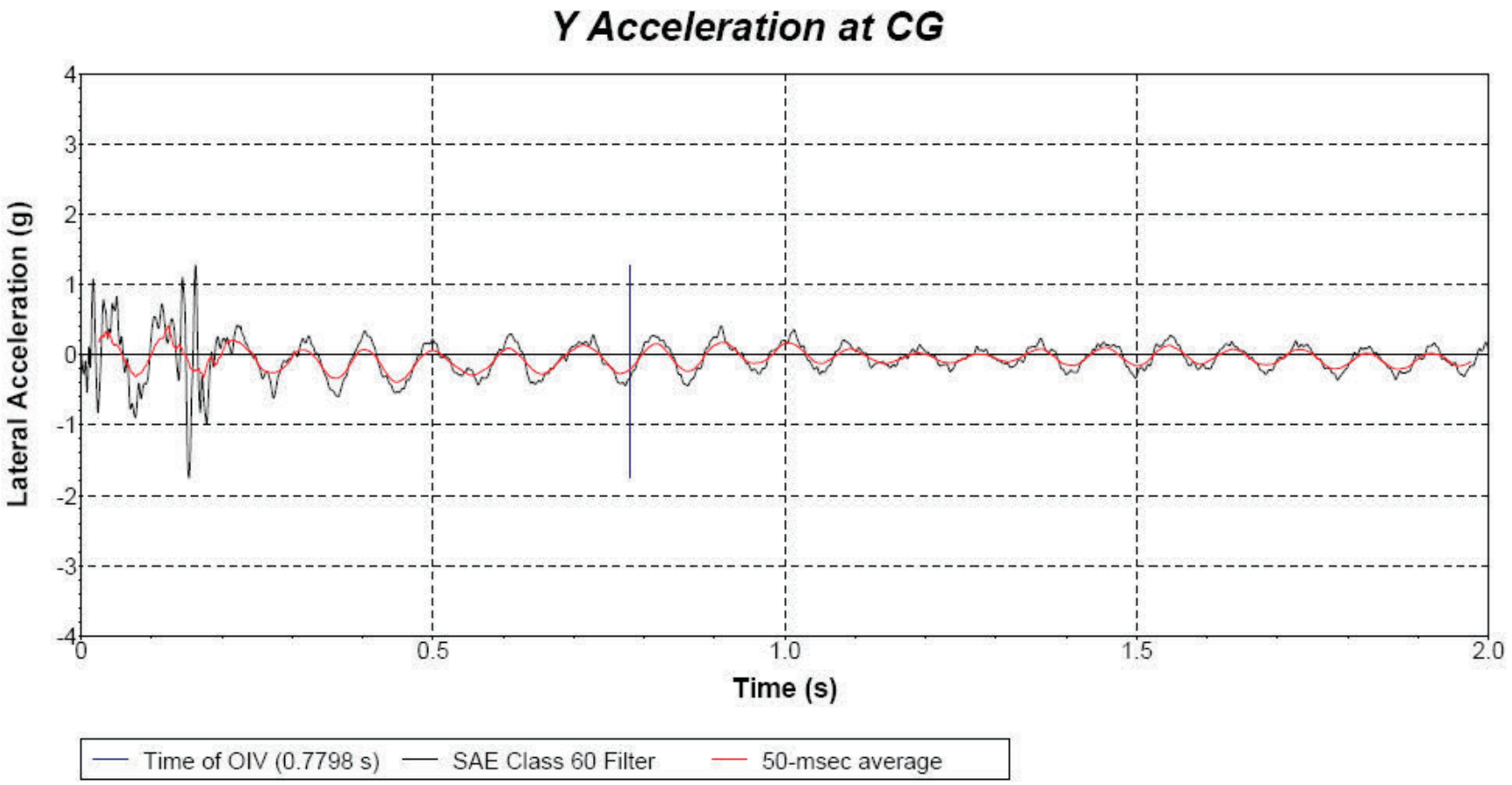


Figure E.8. Vehicle Lateral Accelerometer Trace for Test 690900-PVL-7 (Accelerometer Located at Center of Gravity).

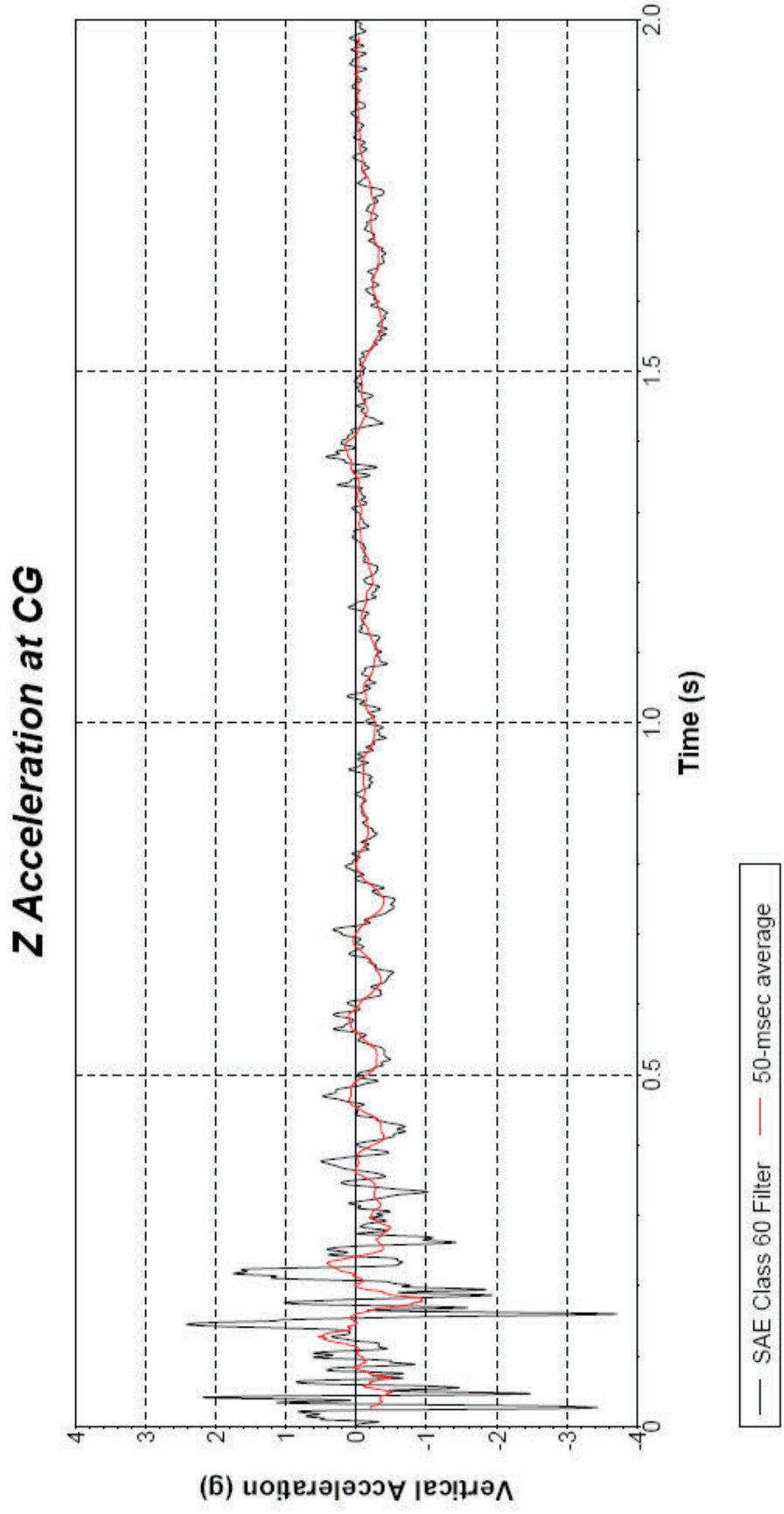


Figure E.9. Vehicle Vertical Accelerometer Trace for Test 690900-PVL-7 (Accelerometer Located at Center of Gravity).